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SUPPURATIVE DISEASES OF THE LUNG DUE TO INSPIRATED FOREIGN BODY CONTRASTED WITH THOSE OF OTHER ETIOLOGY[1]

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THE literature of suppurative diseases of the lung is so huge that one should hesitate to say what it does not contain; but nowhere have I encountered the drawing of a sharp line of distinction, pathological or clinical, between suppurations due to endobronchial foreign body and those of other etiology. Of the existence of such a line we have at the Bronchoscopic Clinic an abundance of clinical evidence, some of which has been presented (1, 2, 3, 4, 5, 6, 7, 8, 9, 18). The purpose of this paper is to call attention, not to bronchoscopy, but to the generally unrecognized difference between suppuration due to foreign body and that due to other causes. In the author's opinion such a high percentage of cures cannot be obtained, bronchoscopically or otherwise, in lung suppuration of other than foreign body origin.

One of the most curious and interesting phases of this subject is the remarkable and complete cure effected by the bronchoscopic removal of a relatively small foreign body from the bronchial focus of a relatively large area of suppuration. Anyone who has contended for months or years with lung suppuration of other etiology, say a post-influenzal abscess for instance, is amazed to see a foul suppurative process of many years' duration involving an entire lobe clear up without further treatment in a few months after the removal of a foreign body from the bronchus tributary to that lobe. Even more remarkable is the fact that after a few years such a lobe will resume its function and neither by physical signs nor the roentgen ray is it possible to detect unusual fibrotic or other permanent pathological change. We have, not simply an odd case or two, but over a hundred of these long-duration suppurative cases illustrative of this clinical fact. The usual chronicity of lung suppuration cases in general has led many an unsuspecting practitioner to treat a patient with copious foul expectoration for years, until there came a day when a roentgenologist revealed a foreign body. Following the bronchoscopic removal of the foreign body the practitioner has been astonished soon to see the foulness of years' standing disappear, later the expectoration cease, and still later the patient make a complete recovery. Such recovery is the rule after bronchoscopic foreign body removal; it is the exception after suppuration of equal duration that has arisen from other causes.

SUPPURATION OF OTHER THAN FOREIGN BODY ORIGIN

The characteristics of pulmonary suppuration are so well known as to need no enumeration here. For purposes of contrast, however, mention may be made of a few of the many types. Diffuse, spreading, suppurative pneumonitis, and sloughing, gangrenous processes

[1]Read at the Congress of the American College of Surgeons, Philadelphia, October 26–30, 1925.

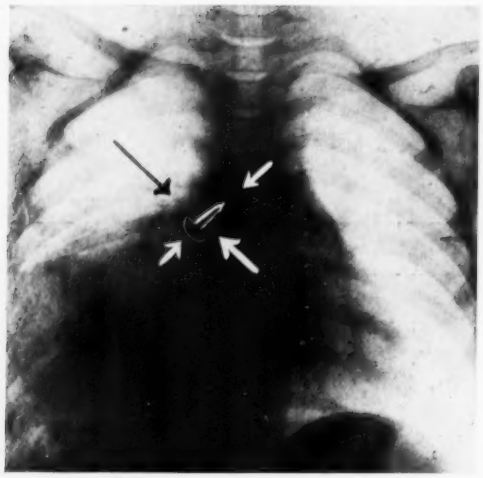

Fig. 1. (Case No. Fbdy. 412.) Roentgenogram[1] showing suppuration involving the entire right lower lobe caused by occlusion of the stem bronchus by a tack. Duration 3 months. At a rib resection, done before admission, for a supposed empyema the pleura was found normal; primary union. Then roentgen-ray examination had revealed the tack. Recovery after bronchoscopic removal.

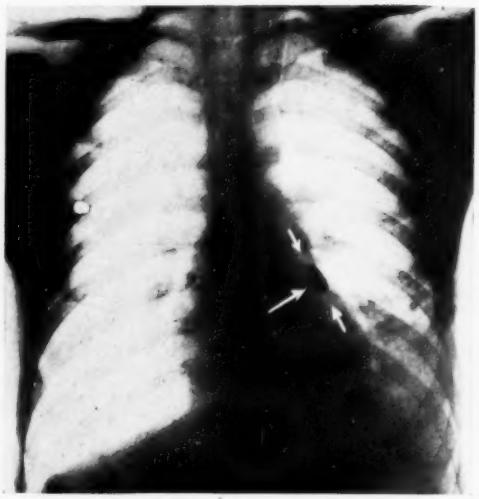

Fig. 2. (Case No. Fbdy. 1106.) Roentgenogram showing abscess of the left lower lobe, in a boy aged 17 years, due to a dental brace inspirated 1 year and 4 months before the child was brought to the clinic for examination, during an abdominal operation. Complete recovery followed the peroral bronchoscopic removal of the dental brace.

are not uncommon as the result of direct trauma, pneumonia, influenza, infarct, and of operations upon the tonsils, upper air passages, and more remote regions. It cannot be too strongly emphasized that such processes are so exceedingly rare that we may say they do not occur after the inspiration of a foreign body into the bronchi. Bronchiectasis of other than foreign body etiology is, when well established, a disease that is exceedingly difficult of cure by medical or surgical means; and even when these are supplemented by bronchoscopic aspirations curative results are slowly and often only incompletely obtained.

PULMONARY ABSCESS AND DROWNED LUNG DUE TO FOREIGN BODY

We have frequently pointed out (1, 2, 3) the anatomical difference between a purulent collection in a section of the bronchial tree due to occlusion of the tributary bronchus, on the one hand, and an abscess with breaking down of the bronchial wall and other lung structures, on the other hand. Bronchoscopic removal of the foreign body before the abscess formation results in a cure within a few weeks. At a later period a longer time is required for recovery, but recovery is almost invariably the ultimate result. It must be remembered, however, that complete breaking down of the tissues, such as is common in post-tonsillectomic, post-pneumonic, post-influenzal, and tuberculous abscesses, with cavitation, air content, and fluid level, has rarely if ever been present in any case of foreign body, of short or prolonged sojourn, coming to the Bronchoscopic Clinic. The pathological processes seem to be rather those of hyperplasia than of liquefaction of tissue. Whether or not this fully accounts for the difference in the clinical course we are not prepared to say, but the clinical fact remains that the 98 per cent of recoveries from suppurative diseases of the lung after bronchoscopic removal of a foreign body is unparalleled by any other form of lung suppuration. This statement is based not upon a case or two but upon such a long

[1]The roentgenograms used in this article, with two exceptions, were made by Willis F. Manges. Those shown in Figure 11 and Figure 18 were made by Frederick W. O'Brien.

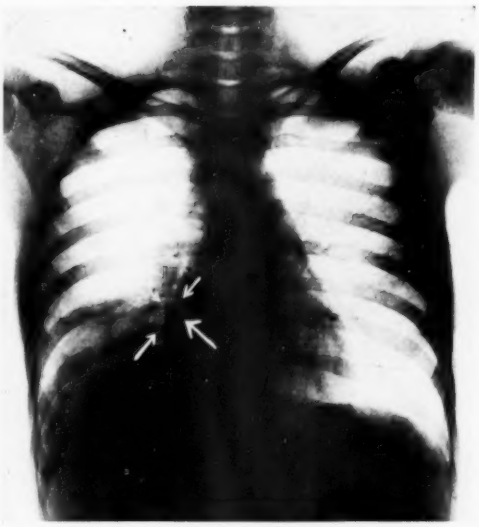

Fig. 3. (Case No. Fbdy. 1121.) Roentgenogram showing the condition in the right lung due to the presence for 3 months of a tooth. Bronchoscopic removal of the tooth was followed by complete recovery.

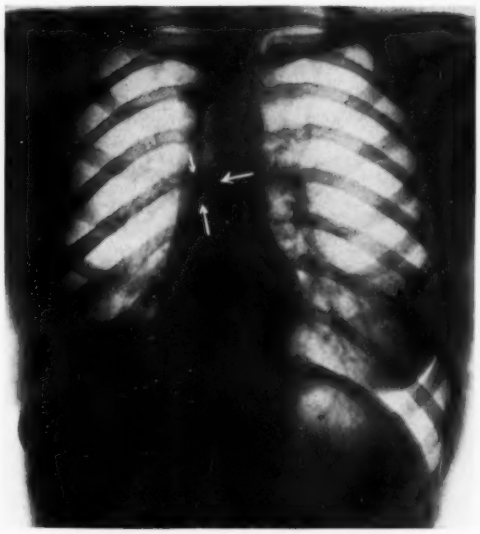

Fig. 4. (Case No. Fbdy. 1148.) Roentgenogram showing abscess of the right lung due to the obstruction of the right bronchus by a tack inspirated 9 years previously. The abscess had been drained externally once 7 years before admission, the opening being allowed to close. Suppuration continued as long as the tack was present but ceased a few months after bronchoscopic removal of tack.

series of foreign body cases as to establish the fact beyond question (1, 2, 3, 5, 6, 7, 9, 18).

CLASSIFICATION OF FOREIGN BODY SUPPURATION

This subject has been extensively studied at the Bronchoscopic Clinic with results of the utmost clinical importance. As many of these studies have been published (1, 2, 3, 4, 5, 6, 8), it will be necessary, here, only to repeat a few facts essential to the presentation of the present subject.

For the proper consideration of pulmonary suppuration caused by the entrance of a foreign body into the lung by way of the trachea and bronchi, it is essential to recognize the clinical fact that there are two groups of foreign bodies presenting a marked contrast in their tendency to produce suppuration; namely, (1) vegetal substances; and (2) other substances.

Another essential is to recognize the clinical fact that suppuration is closely associated with the mechanical condition of the degree and kind of obstruction. These we have (14) classed as:

1. By-pass valvular obstruction, permitting a diminished quantity of air to pass in and out. This results in diminished ventilation and impeded drainage.

2. Check-valve obstruction, in which the air can get in but its escape is hindered. This produces obstructive emphysema in the invaded lung.

3. Stop-valve obstruction, in which the bronchus is completely closed.

The fundamental importance of the foregoing classifications of kinds of foreign body and kinds of bronchial obstruction is shown by their bearing on the clinical facts that a peanut kernel in the bronchus sets up a suppuration that may be fatal to a baby in 2 weeks (8), whereas a screw may produce suppuration in the lung for 40 years (from childhood to middle age), not only without being fatal but without totally disabling the patient.

With the foregoing clinical facts in mind we may proceed to contrast pulmonary suppuration due to inspirated foreign body with that of other etiology.

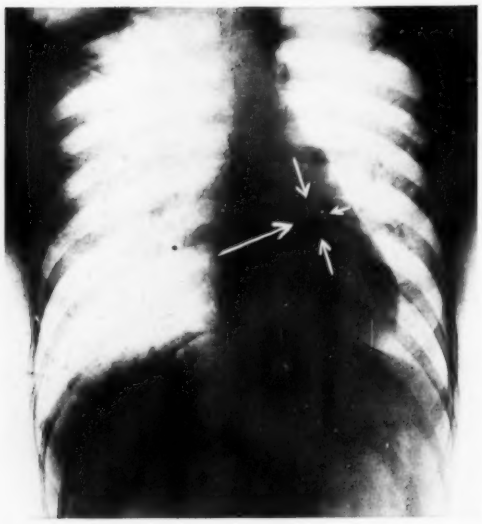

Fig. 5. (Case No. Fbdy. 1153.) The shadow of a dental filling is seen behind the heart shadow. An abscess resulting from the 3 months' obstruction of the left bronchus by the dental filling healed promptly after the bronchoscopic removal of the foreign body.

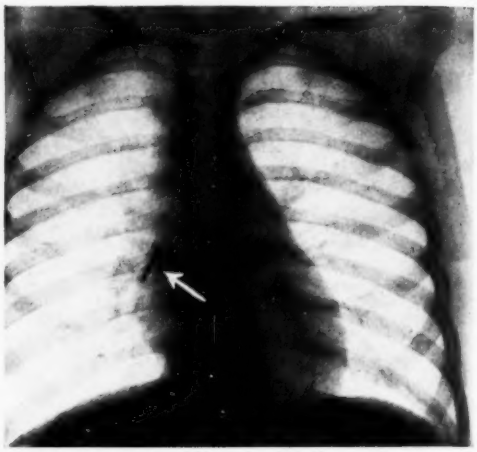

Fig. 6. (Case No. Fbdy. 1237.) The suppurative area distal to the tack, of which the shadow shows in this roentgenogram, disappeared completely without treatment other than the bronchoscopic removal of the tack. The tack had been in the lung for a year and a half.

SUPPURATION DUE TO METALLIC FOREIGN BODIES

The characteristics of this class of cases especially when non-obstructive are (a) the long symptomless interval after the lodgment of the foreign body, and (b) the mildness of the symptoms when they develop. There is no pain and there is usually little or no cough or fever. Shock, prostration, or toxæmia are practically never present. The patient is usually unaware of anything abnormal and only too often the medical attendant is misled into giving a negative opinion as to foreign body. This apparently normal condition of the patient immediately after the inspiration of a foreign body may be contrasted with the grave symptoms at the onset of pulmonary suppuration due to septic infarct, pneumonia, post-tonsillectomic or supposed post-anæsthetic abscess.

In a recent presentation (9) of cases of overlooked foreign bodies in the lungs, I referred to cases in which foreign bodies had been in the lung for periods up to 36 years. A number of such cases have been previously published (3, 4) and many appear in the complete tabulations (1, 2, 3, 7, 18) of our Clinic. From among these cases we may call attention to the following cases by their serial numbers by which they can be identified in the tables referred to:

Case No. Fbdy. 1095. Screw in the lung of a baby from the time it was 15 months old until it was 3 years old, 21 months. The suppuration was continuous after 17 months, but the child was not extremely ill. Complete recovery followed bronchoscopic removal.

Case No. Fbdy. 986. A shawl pin in the lung of a girl, aged 10 years, for one and a half months without a single symptom and without suppuration. After bronchoscopic removal the child could scarcely be said to recover since there was nothing from which to recover. She was normal before bronchoscopy and normal afterward. The foreign body was metallic, and it was non-obstructive, up to the time of removal. We have had over 150 such cases. Later the foreign body would have become obstructive and suppuration would have followed, with all its systemic sequelæ.

Case No. Fbdy. 726. A shawl pin in the lung of a woman, aged 41 years, for 28 years. Here we had the same kind of a pin as in the foregoing case. It was metallic and was non-obstructive for many years, during which time there were no suppuration and no symptoms. Eventually, however, a corrosion of the pin resulted in increasing its bulk and in the production of granulation tissue by the mechanically irritating roughness. The increased bulk and the

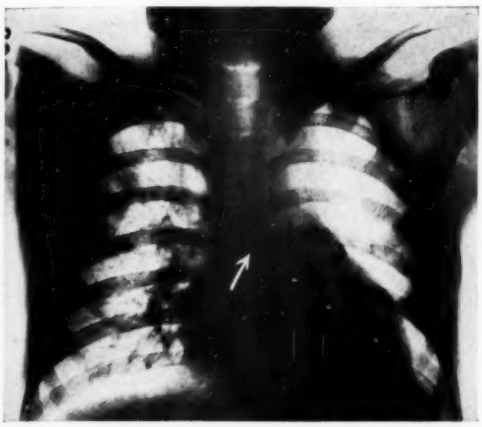

Fig. 7. (Case No. Fbdy. 1156.) In this case the lung suppuration from the presence for 2 years of the hook-shaped piece of wire entirely disappeared after the bronchoscopic removal of the foreign body.

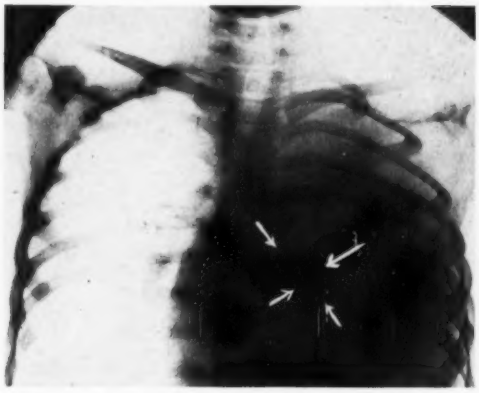

Fig. 8. (Case No. Fbdy. 1250.) Suppuration in left lung, resulting from bronchial obstruction during the 6 years' presence of the staple. Recovery without treatment other than the bronchoscopic removal of the foreign body.

granulations after a symptomless interval of over 2 years' duration evidently resulted in suppuration that in the course of many years increased in severity until an abscess with almost fatal hæmorrhages brought the patient to a state of serious ill health after 28 years' sojourn of the pin. Bronchoscopic removal was followed by entire and complete recovery. There is today no residual sputum, no roentgen-ray or physical signs by which to identify the previously suppurating area.

Case No. Fbdy. 1558. Portion of safety pin in the lung for 15 years. A woman, aged 29 years, having had cough with slight mucopurulent expectoration for 15 years, came under the observation of Dr. S. B. Thomas who advised a roentgen-ray examination of the chest. This revealed a metallic foreign body looking like a bent wire, for the removal of which the patient was referred to the Bronchoscopic Clinic. The patient when questioned vaguely recalled having "swallowed" a safety pin while trying to close it with her teeth when a child of about 14 years of age.

Professor McCrae reported as follows: "Patient's general condition is good. No dyspnœa. No wheeze. Expansion is diminished on the lower right side. There is dullness which corresponds particularly to the lower right lobe, possibly the note was slightly less resonant than normal over the middle lobe. On auscultation breath sounds were distant. I was unable to get any marked alteration on deep breathing and I heard no râles. Vocal fremitus was diminished over the lower right lobe, otherwise the examination seemed negative. Signs suggest lower lobe involvement."

Dr. Willis F. Manges reported as follows: "There is a metallic foreign body very much the shape of a beauty pin except that it has neither a hinge nor an actual spring at the closed end. At the keeper end there is a hinge with a slight projection on the side toward the point. This projection may possibly be a keeper for the point, or the foreign body may be the point-portion of a large safety pin with a part of the spring in a "U" shape bent into the shaft. The point end is toward the median line and directly behind the right border of the heart. It lies in the direction of the right stem bronchus. I suspect that the point has probably embedded itself in the inner wall of the bronchus. There is considerable evidence of a pathological condition in the region of the foreign body as well as distal to it." (Fig. 19.)

Bronchoscopy. The right main bronchus was found occluded by an epithelialized granuloma just below the orifice of the middle lobe bronchus. The granuloma was removed with forceps. The ring end of the pin was grasped with rotation forceps and the Manges roller bronchoscope was pushed down over the pin as far as the ring. The bronchoscope being held rigidly the ring was pulled into the tube-mouth; thus the curve of the pin was straightened out on the roller.

There was no reaction and the patient was discharged a few days later. Her present condition is excellent.

The relatively slight suppuration, the lack of general and local reaction to the presence for 15 years of the foreign body in the lung is in part due to the shape of the foreign body which did not cause obstruction to ventilation and drainage until the development, after some years, probably, of sufficient secondary pathological obstructive tissue. The other factor in the limited degree of illness which was

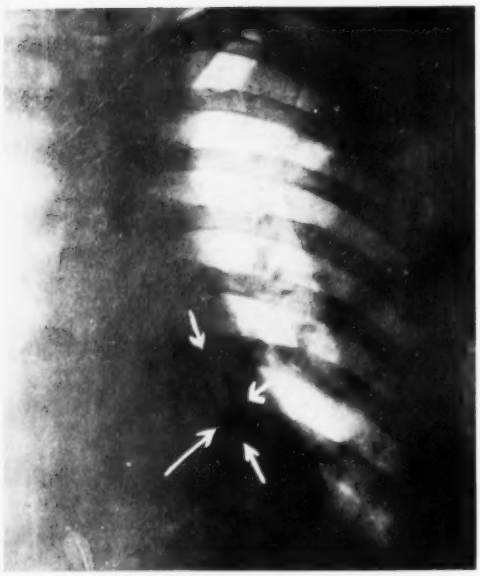

Fig. 9.[7] (Case No. Fbdy. 1393.) The staple shown was aspirated when the patient was 8 years old, and remained in the lung for 15 years. The resultant pulmonary abscess completely healed with no treatment other than the bronchoscopic removal of the staple. The foreign body shadow is retouched for clearness, in this and some of the other illustrations.

associated with 15 years of lung suppuration was due, in our opinion, to the germicidal action of a corroding metallic foreign body.

Case No. Fbdy. 1520. Foreign body (a screw) in the lung for over 40 years. A woman, aged 47 years, visited Dr. Frederick W. O'Brien complaining of ill health since childhood. She had always been "delicate" and subject to attacks of fever, with cough, and some expectoration. Recently there had been local distress over the right lung but the temperature was elevated only slightly and occasionally. Most of her previous medical attendants had made the diagnosis of "chronic bronchitis." Dr. O'Brien made a roentgen-ray examination which revealed a metallic foreign body of the shape of a wood screw deep in the right lung. After the screw was discovered by the ray the patient recalled having been told by her mother that when she was less than 7 years old her mother had found her screaming and crying, locked in a room. When her mother had got into the room the child had said that she had swallowed a screw from a cup. The family physician when consulted said it would pass.

The patient was referred to the Bronchoscopic Clinic for the bronchoscopic removal of the screw.

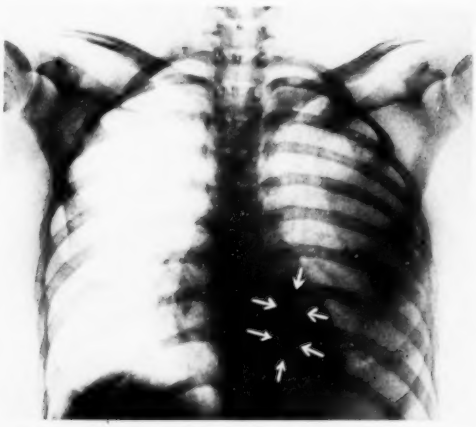

Fig. 10. (Case No. Fbdy. 1261.) The suppuration involving almost the entire left lung was due to the presence of an aspirated safety pin for 4 years. A complete return of the lung to normal followed the bronchoscopic removal of the safety pin.

Dr. Elmer H. Funk reported as follows: "Patient is fairly well nourished; no clubbing of the fingers; heart normal. There is slight wheezing, but no dyspnœa nor cyanosis. Expansion is limited over the entire right side. Percussion note is clear anteriorly, high pitched ("wooden tympany") posteriorly on the right side. Breath sounds over this region bronchovesicular. A few fine crackles are heard near the apex, medium and fine râles from apex to base with greatest intensity near the angle of the scapula. No evidence of cavity formation."

Roentgen-ray examination: Dr. Willis F. Manges reported as follows: "There is a screw about 13 millimeters in length, apparently in the anterior branch of the right lower lobe bronchus in close relation to the mouth of the lower lobe bronchus. There is considerable fibrosis just at the screw and anterior and distal to it. In the lateral view it lies about ½ inch in front of the anterior border of the vertebral bodies and in the anteroposterior view it lies at the level of the ninth rib just about ½ inch to the right of the right border of the vertebral bodies (Fig. 18). Point is downward and I suspect that, because of this, drainage has been maintained very much better than if the head had been downward. There evidently has been some corrosion but it is possible to recognize the shadow of the head of a screw. The lung tissue outside of the area of the foreign body is remarkably clear, in view of the long sojourn of the foreign body."

Blood examination by Dr. I. C. Lintgen was reported as follows: red blood cells, 4,300,000; hæmoglobin, 70 per cent; white blood cells, 7,600; color index, 81; polymorphonuclears, 60; small mononuclears, 34; large mononuclears, 0; transitional, 4; eosinophiles, 2.

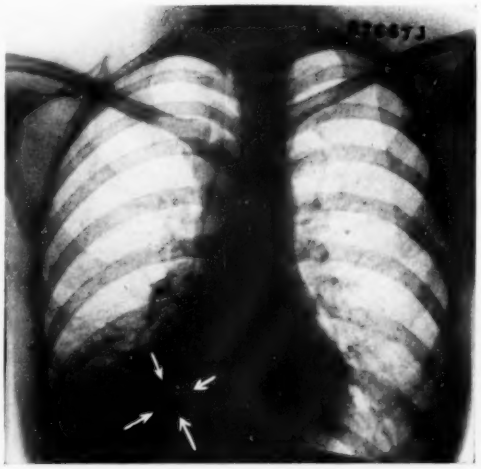

Fig. 11. (Case No. Fbdy. 1274.) Abscess of lower lobe of right lung due to 3 years' sojourn of a tooth. Complete recovery ultimately followed the bronchoscopic removal of the tooth, without other treatment.

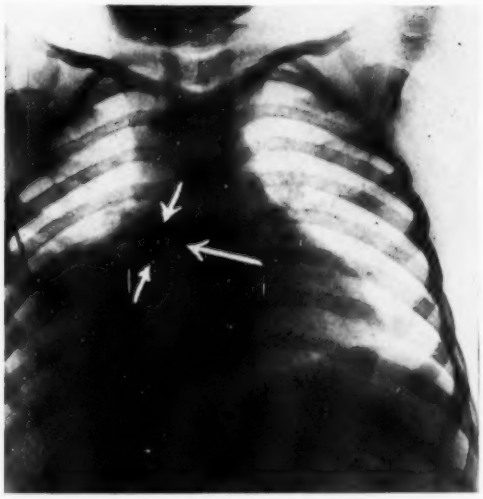

Fig. 12. (Case No. Fbdy. 1279.) The suppuration in the right lower lobe was due to the bullet which had been present for a month, in a child aged 4 years. The lung cleared completely with no treatment other than the bronchoscopic removal of the bullet.

Bronchoscopy. The tracheal and main bronchial mucosa were not obviously diseased. On going down the right stem bronchus, we found the mucosa of the lower lobe bronchus rather pale and cicatricial in appearance, small vessels being visible at a number of locations. Just below the orifice of the middle lobe bronchus the lumen of an internal branch of the lower lobe stem was found to narrow down in a laterally flattened funnel shape to a small (about 3-millimeter) lumen, which was occupied by a small mass of reddish granulations. The patient, not being anæsthetized, was requested to cough, which resulted in squeezing up a small amount of slightly odorous pus. This was wiped away. Dilating forceps were inserted, allowed to expand, and then withdrawn in the expanded position. The closed forceps were cautiously inserted, a millimeter at a time, their direction being checked and corrected at frequent intervals by Dr. Manges. When the head of the screw was reached the forceps were allowed to expand sufficiently to grasp it. The stricture having been previously dilated with the expanding forceps, no resistance was felt on withdrawal of the screw from its substrictural bed. Duration of bronchoscopy was 7 minutes 21 seconds. There was no general reaction; the temperature rose to 99.2 degrees F. that evening but subsided during the night to normal. The patient was discharged 2 days later. Now, 3 months later, she is well on the way to complete restoration of health.

The inspiration of the screw was about 10 years before Roentgen discovered the rays which bear his name. It took about 10 more years for the ray to come into general diagnostic use. For 20 years, then, we may say that the correct diagnosis could have been made at any time had foreign body been thought of as a diagnostic possibility. Moreover the ease and certainty with which any well qualified practitioner can by physical signs detect an extensive area of bronchial obstruction, such as must have been present with a screw of this size in a child less than 7 years old, should have lead to a correct diagnosis. Doubtless there were no symptoms for a long time but the physical signs would certainly have been there, had they been elicited. The history of foreign body could have been elicited by questioning. This failure to consider foreign body as a diagnostic possibility to be excluded in every case of pulmonary disease with or without a history of foreign body, is the result of a shortcoming in the teaching of the medical student. The relatively small amount of pulmonary pathology present in this patient corroborates an observation we have made (1, 2, 3) that metallic foreign bodies seem to have a germicidal action that holds suppurative processes in check until complete obstruction occurs and even then exerts a certain degree of the same power.

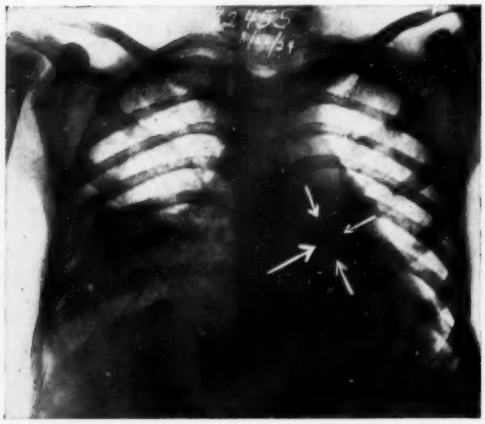

Fig. 13. (Case No. Fbdy. 1383.) Needling and rib resection had both been negative for empyema before the roentgenogram was taken. The suppuration due to the prolonged sojourn of the screw healed completely after bronchoscopic removal of the foreign body.

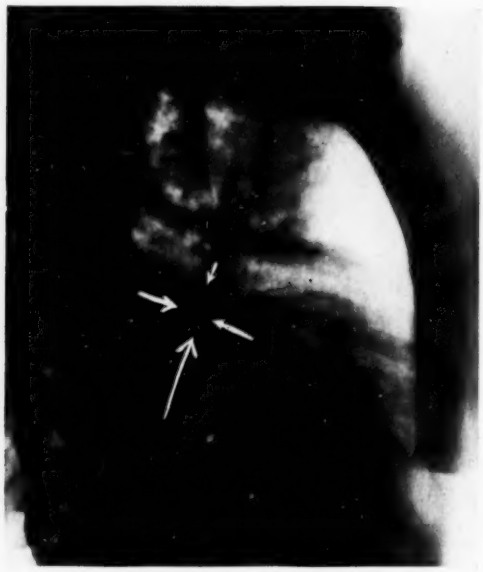

Fig. 14. (Case No. Fbdy. 1394.) The area of suppuration in the right lower lobe was due to the presence for a month of the tooth filling whose shadow shows. Complete recovery followed the bronchoscopic removal of the foreign body.

This is in marked contrast to suppuration of other than foreign body origin, such as that following lobar pneumonia, with its large area of devitalized, often sloughing tissue. In making this comparison, and in contrasting this case with cases of long sojourn of penetrating projectiles, it must be remembered that this foreign body was not encysted. It was in the bronchus, at first surrounded by normal wall, later surrounded by a gradually increasing fibrotic barrier built up by granulation tissue. This granulating area was probably at all times in direct communication with the bronchial stem through which the never copious purulent discharge drained and through which air with its potentially infective agents had access. It is evident that there was a highly efficient defense against the spread of septic processes, and probably also a germicidal effect, ionic or other, exerted by the foreign body itself.

BRONCHIECTASIS DUE TO METALLIC FOREIGN BODY

Bronchiectasis indistinguishable by symptoms, general examination, or physical signs from that due to other causes has been found in many of our cases of prolonged sojourn of a foreign body in the lung. The clinical course of these cases after removal of the foreign body is in such striking contrast to anything seen in well established bronchiectasis due to other causes, as to point to an essential pathological difference; but exactly what constitutes the structural differences we have not been able to determine because of the rarity of mortality and consequent dearth of autopsies. The almost incurable nature of well established bronchiectasis due to the usual causes is well known. On the other hand foreign-body bronchiectasis even when very extensive and present for years usually gets well spontaneously after bronchoscopic removal of the foreign body. Many remarkable examples of this are among our case records, many of which have been published (see appended list of references). The citation of one case will suffice here:

Case No. Fbdy. 659. Well established bronchiectasis cured by bronchoscopic removal of the causative foreign body. A boy, aged 8 years, the son of a physician, had had cough, foul expectoration, clubbing of the fingers, and general ill health since an attack of hæmoptysis and supposed pneumonia at about 2 years of age. Diagnoses of post-pneumonic

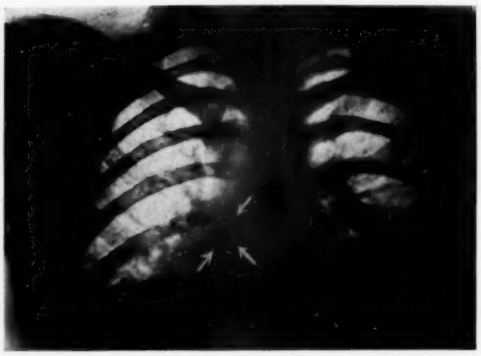

Fig. 15. (Case No. Fbdy. 1397.) The abscess in the right lower lobe followed 3 months' sojourn of the dental filling, the shadow of which is here seen. Recovery to the previous average degree of health followed bronchoscopic removal of the foreign body. The patient had a bronchial history long antedating the foreign body accident.

abscess and of pulmonary tuberculosis had been made and abandoned in favor of a diagnosis of bronchiectasis. A roentgen-ray examination confirmed the diagnosis of bronchiectasis but revealed the presence of a metallic object, about a centimeter in length by about half as much in width, deeply down near the bottom of the right lung, overlapping the liver shadow. He was referred to the Bronchoscopic Clinic for removal of the foreign body. The presence of bronchiectasis was confirmed by (a) the physical examinations of Professor McCrae and Dr. Elmer H. Funk, (b) the roentgen-ray examinations of Drs. David R. Bowen and Arthur V. Sender, and (c) by direct inspection with the bronchoscope at the time of removal of the foreign body. After the removal the expectoration of pus rapidly lessened and within a year had disappeared. At the end of 5 years, during which time there was no treatment other than outdoor living conditions, the patient's father, a physician, wrote to us as follows: "Weight 78 pounds, height 4 feet 11½ inches. Chest expansion 4 inches. Examination of the chest reveals no abnormality. Generally speaking, he is free from colds and he is not troubled with cough. He will be in high school next year."

While it is impossible to say, without a bronchoscopic examination, that the formerly dilated bronchi are now free from sacculation and are normally proportionate in diameter to the present age of the patient, nevertheless the total disappearance of cough and of expectoration are sufficient to warrant an inference of perfect cure and to afford a basis for contrast with the usual course of bronchiectasis due to causes other than foreign body.

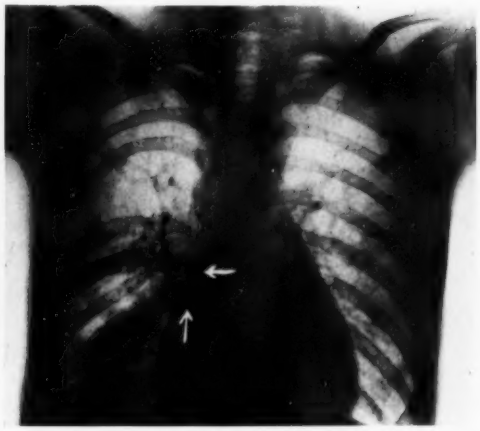

Fig. 16. (Case No. Fbdy. 1447.) The nail shadowed here had been in the lung of the 10-year-old boy for half his lifetime. Attempted removal by external operation had been unsuccessful. Complete recovery followed the bronchoscopic removal of the nail.

SUMMARY OF CASES OF PROLONGED SUPPURATION FROM METALLIC FOREIGN BODIES FOLLOWED BY COMPLETE RECOVERY

In order to convey some idea of the cases on which we base the opinions above expressed we may enumerate a few examples. *These are cases of prolonged sojourn only.* Cases of

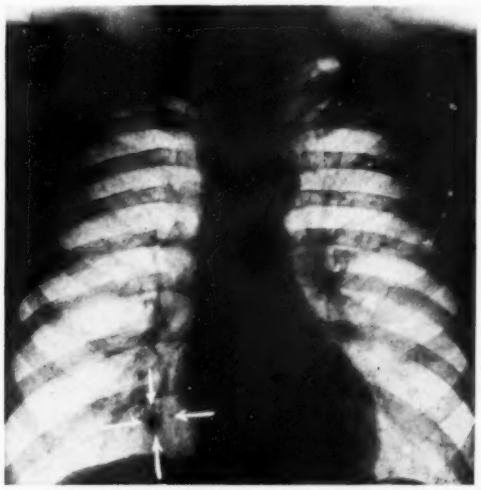

Fig. 17. (Case No. Fbdy. 1415.) The dental filling had been in the lung for over a year. Complete recovery followed bronchoscopic removal of the foreign body.

Fig. 18. (Case No. Fbdy. 1520.) Roentgenogram showing a suppurative area in the right lower lobe due to the presence of a screw for a period of 40 years in a woman aged 47 years. The small amount of pathology present points to the existence of a barrier against suppurative infection by the endobronchial route and also to a germicidal action of metallic foreign bodies in the bronchi.

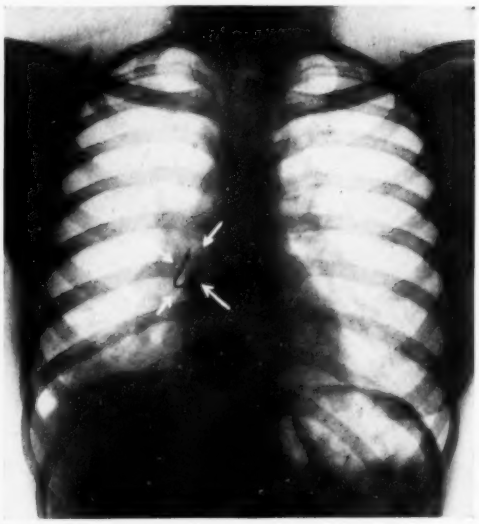

Fig. 19. (Case No. Fbdy. 1558.) A roentgenogram of a woman aged 29 years showing the pathology in the right lung due to the presence of a portion of safety pin for a period of 15 years. The limited amount of pathology points strongly to the existence of a barrier, structural or physiological, against infective invasion of the lung by the endobronchial route, and also to the existence of an antiseptic action resulting from ionization or otherwise associated with the presence of metallic foreign bodies in the bronchi.

short sojourn are not germane to our present purpose. Details of the cases will be found in the tabulated and other published reports of the Bronchoscopic Clinic.

Tacks. We have had over 45 cases of tacks. The long duration cases were as follows: In 14 cases the tacks were present from 1 to 7 months. In 7 other cases the tacks were present for the following number of years: 1½, 2, 2, 2½, 5, 9, 20. With one exception all patients recovered after bronchoscopic removal of the tack.

Staples. Of 15 cases of staples the foreign body was present from 1 to 5 months, in 4 cases; in 3 other cases for 2, 6, and 15 years respectively. In all cases of prolonged sojourn the patient recovered after bronchoscopic removal of the staple.

Screws. Omitting the recent cases, out of 8 cases of screws 4 were in the lung for periods of from 1 to 3 months. In 3 other cases the duration of sojourn was 1½, 2, and 40 years respectively. All patients recovered after bronchoscopic removal of the foreign body.

Pins. Of 60 cases of pins, 50 cases were of short sojourn. In 6 cases the pins were present from 1 to 5 months. In 4 cases the sojourn was 5, 7, 18, and 28 years respectively. In all the long sojourn cases the patient recovered. The patient in whose lung the pin was lodged for 18 years was the daughter of a physician. She has married and is in perfect health.

Safety pins. Omitting recent cases, notable long durations were from 1 to 10 months in 8 cases. Longer sojourns were 2, 4, 15, and 36 years. All patients recovered.

Collar buttons. Omitting recent cases prolonged sojourns were 2 and 8 months and 1, 4, 10, and 26 years. All patients recovered.

Pencil caps and other brass caps. Notable prolonged sojourns were 1½, 2, and 21 years. All patients recovered.

LUNG SUPPURATION DUE TO DENTAL OBJECTS

Teeth, and fillings. Omitting 15 recent cases there were sojourns of from 1 to 7 months in

11 cases. Long durations were 1 and 4 years. One patient, very ill on admission, died of septic pneumonitis before any bronchoscopy was done. This one case and the fact that no sojourn of longer than 4 years is recorded among our cases suggest an unusually aggressive type of suppuration in cases of teeth in the bronchi. This is borne out by the clinical findings in nearly all cases. This rather aggressive type of suppurative process makes the fact that bronchoscopic removal was always followed by recovery of the patient all the more remarkable, when contrasted with suppurative cases of other than foreign body origin.

In cases of a tooth in a bronchus the symptomless interval is short and may be absent; the cough appears early, usually within 24 hours and is generally frequent and annoying, often paroxysmal.

Illustrative of the recovery after the more aggressive suppuration associated with dental foreign bodies, the following case may be cited:

Case No. Fbdy. 840. Tooth in the lung for 6 months. A woman, aged 31 years, was ill in bed for 6 months after extraction of a number of teeth. The symptoms were severe, paroxysmal cough, copious expectoration, and irregular fever ranging up to 102 degrees F., emaciation from 120 to 86 pounds. Diagnoses were pleurisy and tuberculosis. The sputum was always negative. X-ray examinations showed the root of a tooth. In 4 months after bronchoscopic removal the patient had gained 35 pounds in weight, cough and expectoration had ceased, and the patient was perfectly well.

Many cases similar to the foregoing will be found in our published records (1, 2, 3, 4, 5, 6).

PATHOLOGICAL BASIS FOR THE DIFFERENCE BETWEEN SUPPURATION DUE TO FOREIGN BODY AND THAT DUE TO OTHER CAUSES

That there is a difference in the tendency to recovery after the removal of the intruder, however septic it may have been on inspiration, as compared to suppuration due to infective agents that have reached the lungs independent of a foreign body, is conclusively proven by a great mass of clinical data. When we attempt to determine why this is so we get into the realm of inference with all its potential elements of error. A few facts, however, are apparently well established.

The foreign body itself is the chief obstruction to drainage. When approached with a bronchoscope in a case of recently aspirated *obstructive* foreign body, the foreign body itself is obviously occupying the lumen of the bronchus and constitutes the chief obstructive agent. In such cases we find suppuration early. If the foreign body by reason of its size, form, or position, is *not obstructive* we do not find suppuration in recent cases, especially if the foreign body is metallic. If, however, the foreign body has been present for a long time we find the metallic foreign body corroded and buried in granulation tissue, the foreign body and the diseased tissue together constituting the obstruction. As soon as we disturb this obstacle to drainage, pus wells up from below, and it is foul, showing stagnation.

When we go down into the bronchi of a lung that is suppurating from a cause other than foreign body we often find a similar obstructing mass of granulation and granulomatous tissue. But it is an abundantly proven clinical fact that removal of the granulations in the latter class of cases, while ultimately helpful if repeated as often as they re-form, will not produce the remarkable recovery that almost always follows removal of the foreign body, only, from its bed of granulation tissue, in the foreign body class of case.

One inference is that the bulk of the foreign body is itself the chief obstructive factor, and this is doubtless true of many cases. Another justifiable inference is that the presence of the foreign body by its irritation perpetuates the formation of obstructive granulation tissue which disappears after the mechanical irritant is removed. That it does disappear in foreign body cases and does not disappear in other cases we know, by inspection. In many of the non-foreign body cases it often continues to reappear even after many removals.

Is there a barrier to infective invasion of the lung by way of the bronchi? Another inference is that there is a barrier, structural or physiological, to infective invasion by way of the bronchial mucosa. All our records seem to indicate that there is such a barrier. It also seems that the barrier has been more efficient in some cases than in others.

While in some instances this may have been due to the differences in the kind or relative virulence of the bacteria with which the inspirated foreign body was smeared before or during its sojourn in, or passage through, the mouth, it more often seems to have been related to the nature of the substance itself. A few of the many interesting questions in this connection, on which we are still working, are:

Do vegetal substances break down the barrier against pyogenic invasion?

Is there a germicidal action, ionic or other, in cases of metallic foreign body undergoing oxidizing, corrosive processes in the bronchi?

These and other interesting phases of this subject were considered by the author in the Muetter Lecture, and in other publications.

One point in support of the theory of a barrier to bacterial invasion by way of the bronchial mucosa is the very different clinical course run by suppurative processes due to septic emboli as compared to suppurations of foreign body origin. The sudden extreme prostration, pallor, dyspnœa, rapid pulse and profoundly toxic condition of the patient, and the rapid breaking down of lung tissue associated with embolic suppurations, would seem to indicate that the bacteria had got in behind a barrier that seems to have held in check the suppurations secondary to endobronchial foreign body invasion, in all except the cases of vegetal foreign bodies, such as peanut kernels, maize, watermelon seeds, etc., in children. Even in the latter class of cases the removal of the foreign body usually results in such a rapid cure (usually only a few days) as to point strongly to a very efficient defense to invasion by the endobronchial route. The existence of a defensive mechanism against insufflated endobronchial infection, efficient against certain organisms, inefficient against others, has been recently demonstrated on mice in the laboratory by Stillman (17). His findings as to the defensive power of the lung being unable to annihilate certain streptococcic organisms would seem to confirm my opinion that metallic foreign bodies have a germicidal effect. In our hundreds of such cases there must have been many plentifully smeared with streptococci of various kinds and of various degrees of virulence. Streptococci were found in most of the suppurative foreign body cases.

CONCLUSIONS

1. Pulmonary suppuration starting endobronchially and due to the presence of a foreign body is, when contrasted with embolic, post-pneumonic, and post-influenzal suppurations, such a mild, slow, and restricted process and manifests such a tendency to prompt and complete recovery after removal of the foreign body as to suggest the existence of some sort of physiological or structural barrier against the invasion of suppurative processes by the endobronchial route.

2. The characteristics of foreign body suppuration mentioned in the foregoing paragraph are most marked in cases of metallic foreign bodies, which seem to possess germicidal powers. The same characteristics are present in a less degree, minus the germicidal powers, in other kinds of foreign bodies. They are least apparent in the cases of vegetal foreign bodies; but even in these the prompt recovery in almost all cases, if the foreign body has not been long in the tracheobronchial tree, is in marked contrast to lung suppuration of any etiology other than that of foreign body.

3. Complete recoveries in a long series of cases, after foreign body suppuration of from 10 to 36 years' duration, with no treatment other than the removal of the foreign body, is so different from the course of pulmonary suppuration of any other etiology as to call for a separate classification for suppurations due to endobronchial foreign body.

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THE MORTALITY IN IMPORTANT SURGICAL DISEASES, ESPECIALLY APPENDICITIS[1]

By A. MURAT WILLIS, M.D., F.A.C.S., Richmond, Virginia

IN becoming fellows of the American College of Surgeons, we pledge ourselves to place the welfare of the patient above every other consideration. At times, unfortunately, our efforts, at best, will secure for those relying upon our skill merely a measure of relief from their suffering; not infrequently, on the other hand, it may be granted to us either definitely to hasten the recovery of an invalid or actually to prevent a fatal termination of his illness. As surgeons, we are especially privileged, but likewise burdened with responsibility. Our patients are largely recruited from the young and middle aged; if our therapeutic efforts are successful, there is the gratifying knowledge that we have preserved a life of value to its possessor and the community; if we fail, we must face the fact that, through our failure, the patient has been denied long years of successful endeavor. Are our therapeutic attempts becoming more successful? Are more of the patients who are subjected to surgical treatment being definitely relieved of their ailments than was formerly the case? Especially, is the mortality rate in surgical conditions declining with the increase in diagnostic and technical skill?

Reference to the published statistics from most of the leading surgical clinics in this country gives us an answer emphatically in the affirmative. One cannot fail to be impressed with the prevailing note of optimism in these reports. Judging from them the mortality rate accompanying the surgical treatment of diseases of the gall bladder, thyroid, gastro-intestinal tract, and pelvic contents seems to be so rapidly approaching the vanishing point that we look forward to an early day when a failure of the patient to recover may be ascribed solely to that person's natural perversity and not to any dereliction on the part of the surgeon or fault in the method of treatment employed.

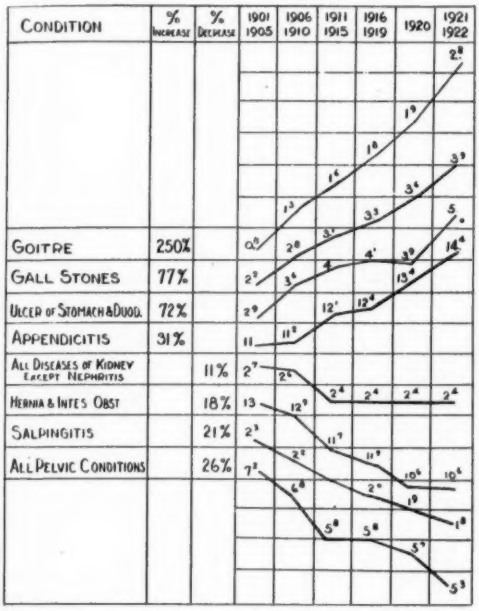
Unfortunately, not all major surgery is carried out under the conditions which exist in the large surgical clinics from which these optimistic reports emanate. Impressed by the brilliancy of the results obtained by these master surgeons and, too often, misled into believing that the technique of a difficult and dangerous operation is simple and free from risk to the patient, a constantly increasing number of surgeons in this country with little experience in such grave surgical procedures are resorting to operative therapy. Are all such operators meeting with the success that appears to crown the efforts of their more distinguished brethren? They rarely discuss their results in the pages of the medical journals, so that direct evidence as to what is being accomplished is generally lacking.

It is possible, however, to obtain some of this evidence by reference to the figures published through the Bureau of Vital Statistics. Here, also, we obtain information of a most comforting nature as regards the mortality rate associated with hernia and intestinal obstruction, surgical diseases of the kidney, and pelvic inflammation. In the five-year period, 1901 to 1905 inclusive, the deaths due to the first of these conditions were 13 per 100,000 population; in 1921, it had fallen to 10.7 per 100,000. In the period 1905 to 1921, the mortality rate from surgical diseases of the kidney decreased 11 per cent; while that due to involvement of the pelvic contents fell over 26 per cent in the same period of time.

It is distinctly disturbing, on the other hand, to find that with some other important surgical conditions, not only do the data of the Bureau of Vital Statistics fail to confirm the belief as to a reduction in the number of deaths, but, on the contrary, show that there is a steadily mounting rate from year to year. Thus, in the five-year period, 1901 to 1905, the number of deaths per hundred thousand from gall stones was 2.2; in the succeeding years, it rose steadily, until in 1922, the last year for which figures are available, it showed an increase of 77 per cent. In the same period of

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October 27, 1925.

TABLE I.—DEATH RATE PER ONE HUNDRED THOUSAND POPULATION; PERCENTAGE OF INCREASE AND DECREASE



time, the mortality rate from gastro-intestinal ulcer increased 72 per cent; that from appendicitis almost 31 per cent; while the mortality rate accompanying thyroid disease showed the stupendous increase of over 250 per cent.

A careful analysis will, I believe, reveal that these differences are not the result merely of chance; there may be found more plausible explanations for the decrease in the mortality rate accompanying the diseases included in the first group; while no less definitely it may be explained why we are having a steady increase in the number of deaths due to gall stones, ulcer, appendicitis, and diseases of the thyroid.

It has come to be fairly universally established that conservative operative methods play an important rôle in the handling of a patient suffering from acute intestinal obstruction. As regards surgical diseases of the kidney, the diagnosis and treatment are left largely to surgeons of especial skill; rarely

TABLE II.—ECONOMIC IMPORTANCE OF DEATHS FROM APPENDICITIS AS COMPARED WITH DEATHS FROM OTHER IMPORTANT CONDITIONS

CAUSE OF DEATH	PERCENTAGE OF DEATHS	
	BEFORE AGE 50	AFTER AGE 50
APPENDICITIS	83%	17%
CANCER	23%	77%
ORGANIC DISEASES OF HEART	20%	80%
DIABETES	29%	71%
GALL BLADDER	32%	68%
ULCER OF STOMACH & DUODENUM	45%	55%
HERNIA & INTESTINAL OBSTRUCTION	48%	52%

does the poorly trained operator undertake such operations as nephrectomy. In pelvic inflammatory processes, it is firmly established that conservatism is indicated with confinement to bed, free administration of fluid, and relief of pain through the use of anodynes; such measures as these are stressed to the exclusion of the radical treatment advocated in former years.

On the other hand, in many of the publications appearing in the medical literature, the necessity of radical treatment of gall-bladder disease is emphatically stressed; along with this, it is made to appear that the operative measures are comparatively simple. Even the layman is coming to consider the loss of his gall bladder the penalty to be paid for the crime of eructating, and he must feel that his local surgeon, so-called, is of little account unless he is capable of accomplishing the removal of this entirely superfluous and trouble-making structure.

With ulcer, we see the successive advance: first, the negation of possible benefit to be derived by medical treatment and the reliance upon the relatively simple operations of gastro-enterostomy and pyloroplasty; next, the insistence upon these methods plus excision of the ulcer; and finally (or is it finally?), the contention that only by sacrifice of a large portion of the stomach or ulcer bearing area of the stomach and duodenum is the patient to be relieved of his sufferings. With appendicitis, there are many, following the lead of Murphy, who stress the importance of early

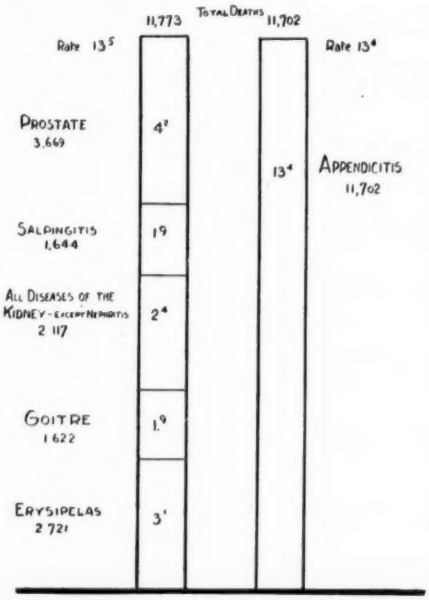
TABLE III.—MORTALITY FROM APPENDICITIS COMPILED FROM 1921 STATISTICS

		Rate per 100,000
Appendicitis 14.4 per cent	Ulcer of the stomach and duodenum	4.9
	Gall stones	3.9
	Pancreas	0.6
	Spleen	0.3
	Goiter	2.7
	Ectopic pregnancy	0.5
	Salpingitis and pelvic abscess	2.1

operation with removal of the appendix, a procedure most to be commended in interval cases or early in the course of an inflammatory attack but one fraught with the most dire possibilities for the patient if rigidly adhered to in all cases of appendiceal involvement.

In a paper read before the American Medical Association, Bernheim has recently called attention to some most pertinent facts in this connection. He says: "The operative deaths in the goiter work of Dr. Crile are hardly more than 1 per cent; the deaths following upon the gall-bladder and common duct work at the Mayo Clinic in 1923 were 5.6 per cent . . . ; Deaver, in his surgery of the upper abdomen reports 597 operations for benign disease of the stomach with 29 deaths . . . ; Balfour just recently reported 74 partial gastrectomies with one death . . . Does anyone believe that surgeons in general have any such results as these?" But it is the example and the teaching of men of this caliber that influence less able surgeons to undertake serious and complicated operations. A subtotal thyroidectomy in the presence of exophthalmic goiter may never be serious to one with Dr. Crile's amazing skill and vast experience; a partial gastrectomy may be simplicity itself to Dr. Balfour, similarly equipped. The removal of a normal appendix from a slim young girl may present no serious difficulties even to our occasional operator; the removal of a perforated appendix in the presence of peritonitis from a corpulent man of 50 is a different story. And yet the rank and file of the profession seem imbued with the idea that all "appendectomies are simple." As a result even the layman views the separation from his appendix with no more uneasiness than that with which he looks forward to a visit to his dentist.

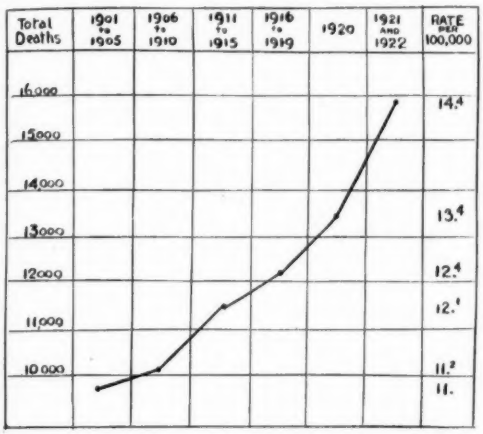
TABLE IV.—APPENDICITIS IN RELATION TO OTHER SURGICAL CONDITIONS. 1920—REGISTRATION AREA 83 PER CENT OF THE UNITED STATES



Another important factor is a lack of uniformity in the teaching as regards appropriate treatment in some of the last mentioned conditions. We see this strikingly illustrated in the case of gastroduodenal ulcer; a small minority of surgeons incline to the belief that surgery is not indicated in all cases. The majority of the surgical profession contends that relatively conservative operative measures are demanded and suffice in most instances of ulcer; while an increasing number is taking the attitude that both of the other groups are in error and that very radical operation is necessary.

No less lack of harmony is apparent concerning the opinions as to appropriate treatment of appendicitis. Representing one extreme are the followers of Ochsner, who advocate conservative measures; standing for the other, are those who believe in operation on every patient as early as he is seen (which may not be early in the course of the disease) with removal of the appendix.

TABLE V.—DEATHS IN THE UNITED STATES FROM APPENDICITIS. TOTAL AREA FIGURED FROM BUREAU OF VITAL STATISTICS. POPULATION 1900, 90 MILLION; 1922, 110 MILLION. PERCENTAGE OF INCREASE FROM 1900 TO 1922, 30.9 PER CENT



It is appalling to realize that the number of deaths annually from appendicitis equals all those from salpingitis, pelvic abscess, surgical diseases of the pancreas, spleen, and thyroid, gall stones, and ectopic pregnancy. The annual toll taken by appendicitis almost equals the combined total of intestinal obstruction, gall stones, and gastric and duodenal ulcer.[1] Before the age of 45, more persons die annually from appendicitis than from cancer. Although the total death rate from cancer is 6 times that from appendicitis, 80 per cent of the deaths from appendicitis occur before the fiftieth year; while only $^1/_5$ of the deaths from cancer occur before the age of 50. Before the age of 60, there are about four thousand more deaths annually from appendicitis than there are from diabetes. Think of what these figures mean from an economic standpoint. The vast majority of those who succumb to appendicitis are lost during their productive years; those who die from cancer or diabetes have, in most instances, passed the stage of usefulness.

[1] The mortality rate from appendicitis is 14.5 per 100,000. This means that with a population of 110 millions in the United States, there would be 16,000 deaths annually—44 deaths a day; 1 every 33 minutes. If the rate of 10 years ago had been maintained there would have been a saving of over 3,000 lives annually.

TABLE VI.—SURGICAL DEATH RATES FROM ACUTE APPENDICITIS. RESULTS OBTAINED AT SEVERAL GREAT CLINICS

	Death rate percentage
Ochsner, Professor of Surgery, University of Illinois, reported in Clin. Surg., 1912, from 1901–1905	4.1
Personal communication, Sept., 1924	2.0
Deaver, Professor of Surgery, University of Pennsylvania, reported in Ann. Surg., 1924, June—	
Using method of Gatch, 1901–1905	10.5
Using the Ochsner method, 1910–1919	3.9
Gatch, Professor of Surgery, Indiana University, reported in Ann. Surg., 1924, June, rate for 1924	8.7

CONCLUSION

Destructive criticism is of small value unless it prepares the way for subsequent improvement. The presentation of facts which has just been made indicates that something is radically wrong with the modern surgical treatment of certain important conditions. Can this be remedied? It would seem that the first step would be the appointment by the American College of Surgeons of a commission, composed of the leading surgical teachers of this country; the function of this commission being to direct a thorough investigation of the whole question, with a view to effecting some degree of standardization of the methods of treatment of these diseases, regarding which, at present, there seems to be such a complete lack of agreement.

INTRAHEPATIC CHOLELITHIASIS[1]

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Division of Surgery

IT has long been known that stones occur in the intrahepatic ducts, but the condition is uncommon even in published necropsy reports. The practical significance of biliary calculi in the ducts of the liver is not of much consequence from a surgical standpoint because of the rarity of the finding. Nevertheless, it must be kept in mind as an occasional cause for recurrence of symptoms after operations on the gall bladder and ducts. In most of the reported cases the symptoms were severe and at operation or necropsy the lesions of the liver and ducts were extensive. The frequency of stones in the gall bladder and the common duct, their less common occurrence in the hepatic duct, and their almost complete absence from the ducts within the liver, have led to the assumption that all stones form in the gall bladder. It is extremely rare for stones to reform in the common duct after their complete removal. The small bits of gravel which sometimes form in the liver probably pass through the ducts without difficulty.

Case 1. A woman, aged 50, was admitted to the clinic October 20, 1913. Her chief complaint was pain in the right upper quadrant of the abdomen. For 10 years she had had repeated attacks of pain below the right costal margin radiating to the right shoulder. The attacks were severe enough at times to require morphine for relief. She was troubled a great deal by indigestion, and occasionally after meals became nauseated and vomited. She had never been jaundiced. For 3 days preceding her visit she had had almost constant severe distress, and vomited every 2 or 3 hours. She was obese, weighing 195 pounds.

On examination there was no evidence of jaundice. Tenderness was present over the region of the gall bladder. Examinations of the urine and blood were negative. Gastric acids totaled 70, and the free hydrochloric acid was 60. Roentgenological examination of the stomach was unsatisfactory.

The patient was operated on October 24, 1913, at which time 4 large stones were found in the common duct, and 3 in the hepatic duct. They were crushed in removal. The gall bladder was greatly thickened and adherent to the pylorus; when cut away it left a thick adherent patch that caused a certain amount of obstruction of the pylorus. The common duct was greatly thickened and adherent to the stomach, duodenum, and gall bladder. Following crushing and removal of the stones, the ducts were washed out, and probes and scoops passed into the duodenum. The gall bladder was removed and a catheter was sewed into the common duct for drainage. The operation was very difficult. Drainage of the wound was provided for by gauze and rubber tissue. The catheter was removed from the common duct on the ninth day. The patient's convalescence was uneventful, and she was dismissed from the hospital on the nineteenth day.

The patient was seen again December 10, 1914, at which time she complained of occasional neuralgic pain over the liver, radiating to the right shoulder and down the right arm. In the preceding 2 months she had had periods of feeling sick, which were not related to meals, and for 10 days she repeatedly vomited large quantities of foul dark material. She complained of soreness in the epigastrium and below the right costal margin. There had been no severe pain or colic. She returned home under medical management.

May 31, 1916, the patient reported that she had felt well until 6 weeks before, when the attacks of vomiting recurred and continued at irregular intervals. There was also some soreness below the right costal margin. The systolic blood pressure at this time was 148, and the diastolic 90. Her weight was 155.5 pounds. Examinations of the urine and blood were negative. The gastric acids totaled 80, and the free hydrochloric acid was 24; there was retention of 700 cubic centimeters. Roentgenological examination of the stomach revealed an obstructive lesion at the outlet.

Operation June 9, 1916, showed the pyloric obstruction to be due to adhesions from the former operation. The liver was apparently in good condition. A posterior gastro-enterostomy was performed. Following this the patient recovered satisfactorily and was dismissed from the hospital on the eleventh day.

February 16, 1924, the patient again came to the clinic. She had had no trouble for 8 years until 10 days before admission, when she became nauseated, vomited, and suffered from generalized abdominal pain which was especially severe in the epigastrium and left flank. The abdomen became distended. Diarrhœa was present at the onset of the attack, but this subsided after 3 days under the influence of medicine. Gas could be passed by the bowel. Vomiting and abdominal pain continued after her admission to the hospital, and repeated gastric lavage was carried out. She was still very obese. The abdomen was uniformly distended and tender. Urinalysis was negative. The hæmoglobin was 80

[1] Submitted for publication, June 30, 1925.

per cent; erythrocytes numbered 4,840,000, and the leucocytes 7,300. The blood urea was 46 milligrams for each 100 cubic centimeters of blood. Clinical and roentgenographic examinations of the chest were negative. Proctoscopic examination revealed an immobile sigmoid.

A diagnosis of intestinal obstruction was made, and operation was performed February 18, 1925. All loops of bowel were found to be greatly distended. The location of the lesion was not determined. Cæcostomy was performed, and immediately large quantities of fluid drained off. The patient's condition was not materially benefited by this procedure and she died 5 days later.

At necropsy the cause of the intestinal obstruction was found to be diverticulitis of the sigmoid, which had produced a large mass in the pelvis and had almost completely obliterated the lumen of the bowel (Fig. 1). The liver weighed 1,549 grams; its surface was smooth, light reddish brown, and on section the markings were regular and distinct. The common and hepatic ducts were moderately dilated. The dilatation of the hepatic duct was proportionately increased as it entered the hilus and extended into the parenchyma of the liver. In the hepatic duct at the point where it entered the hilus of the liver there was a stone about 1 centimeter in diameter. After removal of this stone the course of the hepatic duct was followed into the parenchyma where 10 or 12 other stones were found varying from a few millimeters to 1 centimeter in diameter. One large branched stone, resembling the branched stones was found in the pelves of kidneys, from 4 to 5 centimeters from the hilus of the liver. This stone was lodged in a dilated intrahepatic duct. Analysis of the stones showed that they were composed almost entirely of cholesterin.

The question naturally arises whether these stones had their origin within the liver. There is a possibility that some of the débris from the crushed stones at the time of the first operation was forced into the liver by irrigation of the ducts. Erdmann has drawn attention to this occurrence. However, there can be no reasonable doubt that the large calculi found in the liver formed there and increased in size, regardless of the origin of their nuclei. Frerichs says: "Gall stones may be found in any part of the excretory apparatus of the liver from the roots of the hepatic duct at the margins of the lobules to the termination of the common duct. Gall stones in the interior of the liver are rare. Usually the concretions are in the form of small brown or black grains which may fill the ducts. Sometimes they are large, branched, and coral-like. Cysts may develop around the stones."

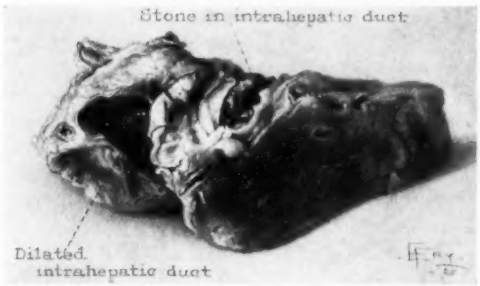

Fig. 1. Portion of the liver showing stone in intrahepatic duct.

Naunyn maintains that bilirubin calcium calculi are frequently formed in the intrahepatic ducts and usually occur in thick, greasy, brownish-black bile.

There are not sufficient data to form an estimate of the frequency of intrahepatic stones. Beer, in 1904, dissected 250 livers of patients who had died from cholelithiasis and found intrahepatic stones in 6 cases. According to Murchison, intrahepatic stones rarely occur in the absence of obstruction of the common duct. Rolleston says that the condition is very rare; he saw only 1 case, that of a man who died from diabetes due to secondary pancreatitis.

The case reported by Vachell and Stevens indicates that intrahepatic stones do not come from the gall bladder. In this case, a man, aged 52, had had attacks of gall-stone colic for 29 years, but had never been jaundiced until the last attack. He was deeply jaundiced and the liver was enlarged. He died while under observation. At necropsy the liver weighed 2,750 grams. There was an abscess between its upper surface and the diaphragm. Its entire surface was covered with small projections caused by underlying calculi. It contained many tiny abscesses. The gall bladder was of normal size, not inflamed, and did not contain either stones or bile. The hepatic duct and upper end of the common duct were markedly dilated and contained more than a hundred stones. The intrahepatic ducts were greatly dilated and contained calculi, mucus, and bile. No part of the liver was free. Five hundred and twenty calculi were counted, the largest of which was

4.38 centimeters long. Many of them were facetted. The calculi contained 18 per cent of cholesterin and 38.9 per cent of calcium bilirubin. Lenhartz also reported a case in which stones were found in the liver, but not in the gall bladder. Chopart observed a patient whose liver contained so many concretions that it could not be cut with a scalpel.

The gross appearance of the liver in the various cases was greatly altered. The liver was usually enlarged. The stones sometimes became inclosed in firm fibrous cysts which might project from the surface. Suppurative cholangitis with the formation of abscesses was not uncommon.

In operating for stones in the common duct it is not very uncommon to find stones in the hepatic duct, as far up as can be explored with a probe. The condition is ordinarily thought to be produced by the stagnant and infected bile behind a stone in the common duct.

The actual finding of stones in the liver at the time of operation is a great rarity, and in this connection the experience of Lewisohn is unique. His patient was a man, aged 31, whose liver was large and nodular, and on its inferior surface was a perforated abscess cavity containing stones. One of the nodules on the upper surface of the liver was opened and found to contain stones. The gall bladder contained stones. Cholecystectomy was performed. The patient recovered but a biliary fistula persisted until it closed spontaneously after 8 months. The stones were analyzed and found to contain 48.11 per cent cholesterin.

In most of the cases of intrahepatic stones which have been reported the patients were acutely and gravely ill, and they were often deeply jaundiced. Rolleston says that these calculi almost necessarily set up jaundice and a good deal of pericholangitis. On the other hand, Murchison says that the symptoms are obscure, that jaundice is absent and the liver enlarged, and that pain or colic may occur. It is common knowledge that the severity of symptoms is not necessarily proportionate to the size or number of stones in the common duct. In fact, it is not unusual to find a large stone in the common duct which has never given rise to jaundice. In 1842, Thomson called attention to what was apparently well known at that time, that the degree of obstruction produced by a calculus in the gall duct is not uniformly proportional to its size. A large branched stone forming a complete cast of the renal pelvis is sometimes seen in a kidney with good function. We have observed a solitary kidney which contained a large staghorn calculus; the patient was seemingly in good health, and renal function was adequate.

Oertel reports the necropsy on a man who died following drainage of the bladder for hypertrophy of the prostate. The gall bladder and ducts were markedly dilated and contained thin bile. A stone, 1.5 by 3 centimeters, was found at the ampulla of Vater and the common duct at the papilla was 3 centimeters in diameter. There were also many stones in the upper portion of the common duct and in both hepatic ducts. The common duct was 4 centimeters in diameter. The man was not jaundiced, and there was no evidence in the liver of previous obstructive jaundice.

In the cases in which a chemical analysis of the stones was made they were found to contain chiefly bilirubin calcium and a smaller amount of cholesterin.

The unique features in the case which forms the subject of this report are: The finding of many large intrahepatic calculi in a liver which was grossly normal, more than 11 years after cholecystectomy, and removal of numerous stones from the extrahepatic ducts; and the presence of this condition without the occurrence of jaundice or any clinical evidence of hepatic insufficiency, the condition being an incidental finding in a patient who died from intestinal obstruction.

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A NEW METHOD OF DEMONSTRATING MEDIAN NERVE LESIONS

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IT is conceded by many writers that vasomotor, secretory, and trophic changes may and often do accompany peripheral nerve lesions. Evidences of this are cyanosis, œdema, redness, and congestion of the area affected by the nerve. Tinel (2, p. 21) says that vasomotor disturbances are practically inevitable in all nerve lesions. He also states: "In all cases the distribution of the vasomotor disturbances is exactly spread over the cutaneous region of the affected nerves." Cyanosis "indicates vasomotor paralysis, acting upon the vasoconstrictor apparatus. It is exaggerated by a dependent position and by cooling; it rapidly diminishes and disappears if the limb is placed in an elevated position. . . . These phenomena show the loss of tone of the vasoconstrictor muscles in the paralysed region. . . . Redness or cyanosis of the skin may in certain cases reach an extreme degree; for instance, we find the index finger in certain irritations of the median and the little finger in certain lesions of the ulnar assume a red, wine-coloured, œdematous, and shiny aspect."

No mention has been found in the literature of the distinct phenomenon cited in the following case reports.

REPORT OF CASES

CASE 1. L. M., a young woman suffered a fracture of the lower ends of the radius and ulna. The fracture was reduced and a cast applied the day of the injury, and for the following 24 hours the patient experienced great pain over the median nerve area. Apparently there was ischæmia of the hand and wrist while the cast was in place. The pressure was relieved.

Three weeks after the accident, when we first saw the patient, there was malunion of the fracture and complete sensory paralysis over the median nerve area in the hand with a positive Tinel's sign 2 inches above the wrist over the median nerve trunk. No vasomotor disturbances were evident but there was profuse sweating over the anæsthetic area and a painless perionychium of the index finger, the result of an accidental wound while the patient was manicuring her finger nail, which was not noticed because of the anæsthesia. She was advised to soak the hand in hot boric acid solutions and to apply large hot boric acid dressings to it, kept hot by the use of the therapeutic light. All splinting was discontinued, active and passive motions encouraged, and after a few days, Bier's hyperæmia was employed 3 times daily, the cuff of a sphygmomanometer being used with the pressure at 80 millimeters mercury, which was the patient's diastolic pressure.

DESCRIPTION OF PHENOMENON

The patient noticed that after the hyperæmia had been established for 2 or 3 minutes, the hand assumed a peculiar appearance. The thumb and first 2 fingers and the radial side of the ring finger gradually became cyanosed and tense, the color extending over the thenar eminence and outlining the sensory distribution of the median nerve. The rest of the ring finger and the little finger and the remaining area of the palm became a mottled red. As long as pressure was maintained, the appearance of the hand remained unaltered; when the pressure was removed, the hand gradually assumed its normal color. This phenomenon was verified by examination and found to be constant, appearing with certainty within 5 minutes after the hyperæmia was established. A more detailed description follows: after 1 minute of pressure, the anæsthetic area became red and the sensitive area mottled; after 3 minutes, the anæsthetic area became

Fig. 1. Appearance of hand in Case 1 a few minutes after application of the sphygmomanometer cuff, the pressure being maintained at about 80 millimeters mercury, at time of presentation, 6 weeks later, and 10 weeks later; //// = color; \\\\ = anæsthesia.

Fig. 2. Appearance of hand in Case 2 a few minutes after application of the sphygmomanometer cuff, the pressure being maintained at about 80 millimeters, at time of presentation, 4 weeks later, and 8 weeks later; //// = color; \\\\ = anæsthesia.

quite cyanotic; after 5 minutes, the anæsthetic area became very cyanotic, the sensitive area plainly mottled, the anæsthetic area cold, and the sensitive area warm; after 20 minutes, the anæsthetic area became extremely cyanotic and the sensitive area darkly mottled.

Under conservative treatment and a continuation of these remedies, the evidence of median nerve paralysis gradually and steadily subsided, sensation returned around the base of the hand, and gradually extended to the finger tips. Six weeks later sensation had returned to the palm and the area of color change had decreased correspondingly. Ten weeks later the color phenomenon could still be elicited but there was no remaining evidence of median nerve paralysis except anæsthesia over the tips of the thumb, index, and middle fingers, as shown in Figure 1.

Case 2. P. L., a young man, injured his wrist and the same phenomenon as that noted in Case 1 was observed. The hand was completely paralyzed over the median area. Operation was decided on. Immediately before operation, and while the patient was anæsthetized, the blood pressure apparatus was pumped to 80 millimeters. The first 3 fingers became cyanotic, and the last 2 fingers and half of the palm became a mottled red (Fig. 2). With the release of pressure, the hand became normal in color.

Operation. There was no vascular lesion, and the arteries and veins were found intact. An incision was made along the course of the median nerve in the forearm, extending down to the palm. The nerve trunk was traced 3 inches above the wrist and into the palm to its arborization. This necessitated the complete division of the anterior annular ligament. No lesion in continuity was found but at the site of the ventral deformity of the radius, about 1½ inches from its lower end, there was evidence of slight pressure upon the trunk, and a few points were found at which the neural sheath was adherent to the surrounding tissues. The adhesions were freed and the neural sheath opened and dissected away from the trunk of the nerve for a distance of about 3½ inches. The wound was then closed.

There was no essential difference between the progress of this case and that of the preceding one. The color phenomenon produced by constricting the arm at diastolic pressure was more definite than in the preceding case, both before and after the operation corresponding precisely to the anæsthetic area and gradually diminishing both in intensity and extent as sensation returned.

Four weeks after the operation there was a return of sensation as far as the terminal phalanges in all fingers, and 8 weeks later sensation was unimpaired and no color phenomenon could be produced.

Case 3. In this instance, the patient had a compound fracture of the elbow joint and a division of the ulnar nerve at the elbow. The patient was seen 8 months after the ulnar nerve had been sutured. Tinel's sign was present to the base of the fifth finger, with anæsthesia of the fifth finger and one half of the fourth finger. The ulnar area of the hand proper had recovered. The ulnar nerve was regenerating at the rate of about 1 millimeter a day. The production of venous retention by means of a sphygmomanometer cuff at diastolic pressure seemed to produce a very slight, fairly discernible difference in color between the anæsthetic and quick areas. This change was so indefinite that several observers could not agree as to its presence, but all noticed a debatable change in color. In this case it is possible that the vasomotor fibers were already functioning in the five fingers and that the sensory fibers had not yet come to their full properties, a reversal of the comparative progress of sensation and vascular control noted in Case 1. However this case was practically one of recovered nerve lesion so that the sign was not expected to be positive.

CASE 4. In this case of a man with a fracture of the radius caused by a fall 18 weeks before presentation, no anæsthetic area of the hand was discernible, although there was some atrophy of the muscles supplied by the median nerve and the patient stated that there had been a sensory paralysis from which he had recovered. The color phenomenon could not be elicited as was anticipated since sensation had returned.

Fig. 3. Case 1. Photograph taken 5 weeks after the nerve lesion occurred. Note the fairly sharp line of demarcation on the ring finger.

The cutaneous symptoms which may be applicable in the cases cited in this report may be partially explained by the fact that "irritation of the nerve trunk in the wound is transmitted by the centrifugal fibers to the sensory corpuscles of the skin. . . . These causes affect the vascular tension generally, and particularly the groups of small capillaries which abound in the papillæ of the skin, the glomeruli of the glands, and the sensory corpuscles" (1, p. 86).

The appearance of the sign which we are describing seems of special value in cases of causalgia, which, according to S. Weir Mitchell, is a group of symptoms characterized chiefly by intense burning pain and irritation referable to the nerve fibers affected by lesions of the nerve trunks. Benisty (1, p. 87) says: "The intense pain and the vasomotor and trophic changes accompanying it are due to what appear to be trivial lesions of the nerve trunks, probably inflammatory in nature. We think that these lesions particularly affect the vasomotor, secretory, and trophic fibers of all the tissues served by this nerve (median). The stronger fibers, such as the motor, are only slightly interfered with by this irritative process, as may be seen by the paresis, tremor, and twitching; other fibers, such as the secretory, may in some cases be entirely destroyed, but the great majority undergo a kind of irritation, which reacts on the capillaries of the papillæ of the skin, on the sensory corpuscles, the skin glands, the subcutaneous cellular tissue, the joints and bones, etc., resulting in the complex of symptoms described by Weir Mitchell under the term 'causalgia.'"

The close proximity of nerves and arteries leads one to suspect that injuries to the nerves might cause vascular disturbances. Benisty (1, p. 110) states: "When there are pronounced vasomotor changes, with signs of œdema of the fingers, glossy, cyanosed, or purplish skin, and trophic changes consisting in ulceration and deformity of the nails, an associated vascular lesion should be suspected, because, on account of the close proximity of nerves and arteries, this lesion is very common."

The median nerve is supplied with a branch of the brachial artery, which penetrates it down the length of the arm. In the forearm the ulnar supplies it with the artery of the median, which accompanies the nerve along its whole course. The branches of the median nerve in the hand are supplied by a number of arterioles, independent of those already mentioned.

Benisty further states: "In partial paralysis uncomplicated by any vascular lesion, vasomotor and secretory troubles are considerable. The skin is cyanosed; it is colder and perspires more than the healthy part of the hand (1, p. 67).

"It is easy to define the share this system (sympathetic) takes in the case of the sciatic, as it is known that most of the vasomotor fibers of the lower extremity accompany this nerve. This fact has been confirmed by Claude Bernard's classical experiment, in which he performed section of the sciatic nerve on a rabbit and afterwards noticed active vasodilatation of the blood vessels of the foot, with local rise of temperature. Physiological experiments on the upper extremity have not been as numerous or as definite (1, p. 82).

"Vasomotor disturbances are the most characteristic disturbances, and lead us to suspect that an arterial wound is present in addition to the lesion of the nerve. When they are very pronounced the skin takes on a reddish-purple tint, as if it had been exposed to the cold for a long time, or else it is bluish-black in colour, and in the latter case it is accompanied by that succulent appearance already mentioned. The least puncture in that case, such as the pin-prick one gives in testing sensibility, makes the blood gush out. Sometimes these vasomotor disturbances are generalised in the hand or foot; in other cases they are localised in one or in several fingers (very often the index finger, at other times in the three last), and they are then still more noticeable. In other cases, particularly in those where vascular obliteration is compensated by collateral circulation, the vasomotor troubles are less pronounced and consist only in a reddish tint of the skin of the whole extremity of the limb; but from time to time the patient passes through real attacks of asphyxia of the extremities. The local temperature is always lowered, sometimes several degrees in comparison with the healthy side. The hand and fingers are cold, whatever the external temperature may be. . . . The disturbance of objective sensibility consists in complete, extensive anæsthesia of segmentary type, with constantly changing localisation, and bearing no relation to the peripheral distribution of the nerve filaments. This anæsthesia sometimes occupies the extremity of all the fingers, sometimes the whole of the three last fingers or all the index finger, or the entire hand or foot" (1, pp. 215 and 217).

This new method permits us to produce an immediate and positive definition by color of the areas affected by some nerve lesions. The appearance of these areas is very similar to their appearance in some cases of long-standing nerve lesions, as has been described above.

CONCLUSIONS

The value of this sign seems to be in its objective qualities. It is a sign which cannot be feigned and as such is of great value in differentiating the malingerer from the unfortunate. It presents the means of delineating in a graphic manner cutaneous areas the nerve supply of which is blocked. It supplements the tactile tests and should be a useful means of studying the physiology and pharmacology of vasomotor control. Its value lies in the facility with which it may be produced in recent cases contrasted with the length of time required to produce visible vasomotor disturbances as they appear in chronic cases.

We realize that the appearance of this sign in 2 cases does not establish it as a constant or unvarying sign of peripheral nerve lesions, and that therefore the absence of this sign is of no importance. *However, the presence of this sign establishes objective evidence of a nerve lesion.*

We have not had opportunity to test for this sign in complete division of the nerve. This report will be supplemented by the report of a larger series of cases at a later date.

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SPLENECTOMY AS A THERAPEUTIC MEASURE IN THROMBOCYTOPENIC PURPURA HÆMORRHAGICA

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THE etiology of purpura hæmorrhagica is not known, the pathology is ill-defined, the differential diagnosis is at times difficult. It is not strange that the therapy should be empirical; empirical to this extent at least, that nothing is done either by transfusion or splenectomy, the two recognized measures in the treatment, to remove a known cause.

The rationale of splenectomy consists in the fact that many of the cases of chronic purpura have a splenomegaly and that inasmuch as removal of the normal spleen results in an initial increase in blood platelets, the procedure seems logical in a disease characterized by a low platelet count. Credit for the suggestion of splenectomy as a cure for purpura hæmorrhagica is usually given to Kaznelson of Prague, who did the first splenectomy in this disease in November, 1916.[1] It is but fair to state that Dr. Alfred Hess of New York City suggested this therapy in 1915. In a communication from Dr. E. W. Peterson,[2] he says: "I find in looking up my record of S. M. that Dr. Hess saw the patient with me in 1915, and suggested that we do a splenectomy to see if it would correct the blood dyscrasia." The patient left the Postgraduate Hospital but was readmitted on August 16, 1917. (See Case 71 in this paper.) Dr. Hess, later in 1917, emphasized the possible advantages of splenectomy in a paper entitled "A Consideration of the Reduction of the Blood Platelets in Purpura."[3]

There are two very good reasons for the enthusiasm in the profession regarding the operation of splenectomy in so-called thrombocytopenic purpura or idiopathic purpura: first because of the failure in many cases of medical measures including transfusion to control the main symptom, bleeding; second, because in the majority of cases of chronic purpura, of the amazing immediate improvement, both subjective and objective. This has resulted in a popular conception in the profession that splenectomy is an infallible remedy, so it is being applied rather indiscriminately to cases improperly selected and not always correctly diagnosed. In the English and American literature, individual cases, or at the most, small groups have been reported without adequate follow-up notes. As yet the collected cases with late results have not been reported. It is with this purpose in mind that the writer has reviewed the literature, and as a result of a questionnaire, sent to members of the American Surgical Association, he has added some 29 unpublished cases, including 3 of his own, making a total of 80 cases of purpura hæmorrhagica in which splenectomy was used as the therapeutic measure.

An attempt will be made (1) to point out certain evidence that the disease called thrombocytopenic purpura is not a distinct entity but a phase of a deranged reticulo-endothelial system, and that merging into this group are other forms of hæmorrhagic disease not benefited by splenectomy; (2) to differentiate the type of disease suitable for splenectomy; and (3) to evaluate the final benefit of splenectomy in the chronic type of the disease.

In the study of diseases of the blood, disturbances of the blood-forming apparatus and the blood-destroying apparatus, or both, must be considered. Intimately associated with the blood-destroying apparatus, in fact a large part of it, is the system of cells named by Aschoff,[4] the reticulo-endothelial system—a term much in use in the literature at the present time. One particularly interesting function of this system of cells is to devour the used up red and white corpuscles and the platelets of the circulating blood, and to metabolize them. These cells are found in the sinuses of the lymph nodes, the blood sinuses

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[2] Personal communication, May, 1925.
[3] Proc. Soc. Exper. Biol. & Med., vol. xiv, p. 96.
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of the spleen, the capillaries of the liver lobules, the capillaries of the bone marrow, in the connective tissue as wandering cells, and in contact with capillaries as Rouget cells. A striking morphological characteristic of the cells of this system is their vital staining, namely, the uniform granular deposition of a dye-stuff *in solution* in the living cell bodies without in any way injuring them.

It is evident that a system of cells, such as the reticulo-endothelial system, whose particular function is the digestion of blood cells, may show variations of dysfunction both in degree and in the distribution of the site of the dysfunction. Thus one form of dysfunction would seem to be definitely limited to the reticulo-endothelial cells of the spleen as in hæmolytic jaundice. Overactive destruction of red cells in this organ results in an anæmia and jaundice. Removal of the spleen, because the derangement is limited to this organ, results in a cure.

Another form of dysfunction, such as is found in Gaucher's disease, is not limited to the spleen, but the altered reticulo-endothelial cells are found in lymph nodes and bone marrow and liver. Splenectomy in this disease can remove only the major part of the lesion.

Inasmuch as the reticulo-endothelial cells get rid of the jaded or excessive blood platelets, it is logical to think that in a disease such as purpura hæmorrhagica, in which a low or absent platelet count is a prominent feature, some part of this system is overactive. If the overactive cells are largely limited to the spleen, its removal would promise immediate good results, and probably permanent results. But if the entire reticulo-endothelial circle is involved, splenectomy would do no more than remove a part of the overactive apparatus, and such a major procedure in the presence of a profound vascular disturbance, as in the acute form of purpura, is extremely hazardous to the patient.

In some of the blood diseases involving the blood-forming apparatus, there is apparently an associated disturbance or overactivity of the blood-destroying or reticulo-endothelial apparatus as well. Thus in some cases of aplastic anæmia and in certain of the leukæmias, there is noted a marked decrease in blood platelets and a tendency to bleed. Splenectomy in these conditions is illogical because the lesion is not limited, even partially, to this organ.

The relation of decreased blood platelets to purpura hæmorrhagica is well recognized. Denys in 1887 first called attention to this fact. Whether this decrease in blood platelets is due to the failure of the megacaryocytes of the bone marrow to form new platelets or to an overactivity of the reticulo-endothelial cells in destroying them is still a moot question. The general opinion would seem to favor the theory, championed by Kaznelson, that the blood platelets are formed in normal numbers, but are destroyed by overactive phagocytosis in the spleen and other parts of the reticulo-endothelial system.

It is furthermore generally agreed that the blood platelets are the most important formed elements in the blood clotting phenomenon, and that they produce a thromboplastic substance. The severity of the bleeding in purpura would therefore seem to depend upon (1) the intensity of the thrombocytolysis; (2) the extent to which certain cells of the reticulo-endothelial system engaged in thrombocytolysis are distributed in spleen, liver, bone marrow and lymph nodes; (3) the permeability of the capillaries to the circulating blood. This latter consideration is the least understood of the three. The decrease in platelets may favor the ready egress of red cells through the potential spaces between the living endothelial cells of the capillaries. On the other hand, the Rouget cells, classed by Aschoff[1] as reticulo-endothelial cells, may play an active part in the permeability of the capillaries. Krogh[2] and his pupils have made the most valuable contributions to the study of the capillary system. Rouget[3] in 1873 first called attention to the existence of peculiar contractile cells on the walls of capillaries, whose ramified prolongations of cell body protoplasm irregularly encircled the capillary wall. Vimtrup[4] working in Krogh's labora-

[1] Aschoff, L. Lectures on Pathology. New York: P. Hoeber, 1924, p. 13.

[2] Krogh, A. The Anatomy and Physiology of Capillaries. Yale Univ. Press, 1922.

[3] Rouget, Ch. 1873.

[4] Vimtrup, B. Ztschr. f. d. ges. Anat., lxv, 150.

tory, confirmed Rouget's long forgotten findings and named these cells Rouget cells, after their discoverer. Aschoff disputes the findings of Vimtrup as regards the contractility of the cell body but considers them a unit of the reticulo-endothelial system. It is conceivable that these Rouget cells, stimulated by the same agent that is active in other parts of the reticulo-endothelial system, might disturb the permeability of the capillary wall to the blood stream facilitating the escape of blood into the tissues.

In a case of acute purpura hæmorrhagica the writer undertook with Dr. M. J. Schoenberg to study the capillary network of the skin of the forearm while applying the Hess tourniquet test. It happened that at the time the patient did not show the positive test so that the production of petechiæ could not be visualized. The patient was very anæmic at the time and had a low blood pressure, so that the identification of the skin capillaries was difficult.

The efficacy of splenectomy in purpura depends upon whether the major part of the thrombocytolysis is taking place in the spleen and upon the inciting cause or agent. In the so-called chronic type of the disease, with the spleen hypertrophied, this would seem to be the case, for it is in this type that removal of the spleen produces brilliant and lasting results.

That the normal spleen destroys thrombocytes is favored by the fact that there is practically always a sharp rise in the platelet count after splenectomy, both in experimental animals and in clinical cases. But there are other definite factors that cause a thrombocytolysis, either by direct action or by overstimulating the elements in the reticulo-endothelial system that normally destroy thrombocytes. Cole,[1] in 1907, first demonstrated that the platelets could be destroyed in one animal by injecting into it antiplatelet serum developed in another animal. Other workers have reproduced the clinical signs and the blood changes characteristic of purpura by subcutaneous injections of antiplatelet serum.

The same results have been obtained by injecting the by-products of streptococcus and pneumococcus. And it is known very definitely that the lighting up or the failure to drain of a streptococcus focus, as in an antrum or sinus infection, will result in a great diminution of the thrombocytes, and an appearance of petechiæ and purpuric bleeding. It may be that the poisons from bacteria may stimulate some element in the reticulo-endothelial system to an excessive thrombocytolysis. This factor of infection is a most important one and may be the underlying cause even in the so-called idiopathic purpura cases.

[1]Cole, R. I. Johns Hopkins Hosp. Bull., 1907, xviii, 261.

THE TYPE OF CASE SUITABLE FOR SPLENECTOMY

Purpura hæmorrhagica is characterized by five fairly definite findings:

1. A low or absent platelet count,
2. A prolonged bleeding time,
3. A failure of the clot to retract,
4. A normal clotting time,
5. The appearance of petechiæ in the skin of an extremity below the tourniquet, applied so as to shut off the venous but not the arterial flow.

It differs from hæmophilia in that there is no history of bleeders in the family; it is not inherited; it is more common in women than in men; the blood clotting time is normal; petechiæ and hæmorrhages are not so characteristically associated with trauma. It is at times difficult to differentiate from an acute aplastic anæmia, but in purpura there is almost always a leucocytosis as compared to a leucopenia in aplastic anæmia.

The main point to decide, once the diagnosis is made, is whether the patient has the disease in the chronic recurrent form or whether it is an acute fulminating type. The former type is usually promptly and permanently cured by splenectomy, the latter type is seldom helped by the procedure. The chronic recurrent type of the disease gives a history of repeated attacks of petechiæ, purpuric areas, irregular bleeding from gums, and in women, menorrhagia. Bleeding is as a rule not very profuse and is not so apt to occur into the alimentary canal or into the parenchyma of the organs. The fact that splenectomy cures would imply that the major disturbance

REPORTED CASES OF SPLENECTOMY FOR THROMBOCYTOPENIC PURPURA HÆMORRHAGICA

Case No.	Author Operator	Sex	Age	A=Acute C=Chronic	Duration of symptoms	Bleeding from or into	Hgb.	R.B.C.	Blood platelets B.P.	Clotting time	Bleeding time	Clot retraction	Hess' tourniquet test	Blood findings after splenectomy	Recurrence of symptoms	Follow-up interval	Result
1	Kaznelson (21 and 22) Schloffer	F	36	C	10 yrs.	Uterus, skin	60	3,700,000	20,000	?	?	24 hrs.	?	B.P. 500,000	None	6½ yrs.	Good.
2	Kaznelson (22) Schloffer	F	27	C	7 yrs.	Nose, skin	37	3,100,000	3,500	?	?	None	?	B.P. 240,000—3 mos. 33,000 8 mos. 11,000	3 mos. Few petechiæ 8 mos. Few petechiæ	6 yrs.	Good.
3	Kaznelson (22) Schloffer	F	11	C	3 yrs.	Nose, skin	120	5,500,000	6,700	?	?	None	?	B.P. 3rd day 260,000 9th day 9,000 8 mos. 6,000	2 yrs. Severe epistaxis 6 yrs. Severe bleeding after abortion	6 yrs.	Fair.
4	Kaznelson (22) Schloffer	F	20	A	1 mo.	Nose, gums, uterus	74	2,600,000	1,800	?	?	None	?	Did not respond to radiotherapy. Died on operating table.	Autopsy: Marked degeneration of and bleeding into myocardium		Died.
5	Kaznelson (22) Pamperl	F	30	C	years	Nose, skin, uterus	43	3,000,000	1,300	?	?	?	?	B.P. 2 hrs. ante-op. 42,000 1st day 385,000, 2d day 530,000 5 wks. 960,000 Last examination 200,000	Periods normal No recurrence	?	Good.
6	Beneke (2) Muhsam	F	20½	C	1 year	Nose, uterus	25	1,200,000	66,600	?	?	?	?	B.P. 2d day 340,000 R.B.C. 2d day 3,250,000	No recurrence	5 yrs.	Good.
7	Ehrenberg (8) Mathaei	F	19	C	4 yrs.	Nose, skin, uterus	15	2,100,000	0	?	?	?	?	B.P. ante-op. none, 2 hrs. postop. 800,000, 5th day 600,000 2 mos. 60,000, 4½ yrs. 19,000	No recurrence	4½ yrs.	Good.
8	Halban (15)	F	17	C	18 mos.	Uterus, nose	40	3,000,000	Very few	?	17 min.	?	?	B.P. 3 mos. 170,000 R.B.C. 3 mos. 4,500,000	No recurrence	6 mos.	Good.
9	Minkowski-Herfarth (17 and 25) Kuettner	M	53	C	52 yrs.	Nose, skin	56	5,200,000	2,800	Normal	19 min.	None	?	B.P. 7 hrs. 55,000 5 days 100,000 2 mos. 31,000 2½ yrs. 365,000	No recurrence	2½ yrs.	Good.
10	Brill-Rosenthal (4) Berg	F	19	C	14 yrs.	Nose, skin, uterus	38	2,270,000	6,400	10 min.	10 min.	None	+	B.P. 24 hrs. 225,000 2 days 295,000 11 days 5,000 4 mos. 20,000	Slight bleeding from gums for a short time after splenectomy	4 mos.	Good.
11	Brill-Rosenthal (4) Beer	M	15	C	3½ yrs.	Nose, skin	38	2,600,000	27,500	8 min.	13 min.	None	−	B.P. 1st day 12,000 3d day 1000 15th day 4,000 5 mos. 50,000	No hæmorrhages	5 mos.	Good.
12	Bass-Cohen (1) Neuhof	F	8	C	3 yrs.	Nose, skin	60	5,200,000	11,000	4 min.	20 min.	None	+	B.P. 1 hr. 42,000 1 day 80,000 4 days 220,000 1 mo. 90,000	No recurrence	5 mos.	Good.
13 to 18	Rosenthal (30)	Cases 13–18 incl. classified as chronic purpura hæmorrhagica. Results following splenectomy at intervals not stated, were all good.															
19, 20	Rosenthal (30)	Cases 19, 20 were acute cases. Both died shortly after operation.															Died.
		Cases 10–20 incl. reported from Mt. Sinai Clinic.															
21	Giffin (12) C. H. Mayo	F	31	C	14 mos.	Nose, gums, skin, uterus	56	3,300,000	100,000 to 200,000	Normal	Prolonged	Slow	+	B.P. 6 hrs. 200,000, taken every 2d day, varied from 175,000 to 700,000. 16th day 365,000. 16th day bleeding time 2½ min.	No recurrence	20 mos.	Good.

22	Giffin (12) W. J. Mayo	F	23	C	13 yrs.	Uterus, skin	55	4,400,000	62,000	5½ min.	6½ min.	?	?	B.P. 1st day 86,000, 6 d. 630,000 16th day 214,000 5½ mos. 150,000	12 mos. infected vaccination with recurrence of petechiæ	14 mos.	Good.
23	Giffin (12) C. H. Mayo	M	24	C	12 yrs.	Gums, nose, skin	Normal	Normal	74,000 to 260,000	9 min.	20 min.	None	+	B.P. 14th day 260,000 Bleeding time 2 min.	5th day some nosebleed No hæmorrhages since	10 mos.	Good.
24	Giffin (12) C. H. Mayo	F	11	C	5½ yrs.	Nose, skin	56	3,480,000	46,000 to 54,000	5 min.	38 to 60 min.	None	+	B.P. 1st day 100,000. B.T. 8 min. 3rd day 980,000 5th day 430,000 3 wks. 50,000	4th to 6th week had nosebleeds following coryza, also petechiæ. No bleeding after that	9 mos.	Good.
25	Giffin (13) C. H. Mayo	M	32	C	2 yrs.	Skin, kidney, bowel	83	4,300,000	36,000	6 min.	15 min.	None at 2 hrs.	+	B.P. 6th day 680,000 10th day 670,000 11th day 810,000 20th day 180,000	No recurrence	4 mos.	Good.
26	Giffin (13) C. H. Mayo	F	11	C	5 yrs.	Nose	38	3,500,000	54,000	7½ min.	10 min.	None in 3 hrs.	+	B.P. 3rd day 640,000 5th day 470,000 6th day 780,000 18th day 88,000	No recurrence	3 mos.	Good.
27	Giffin (13) W. J. Mayo	F	15	C	10 yrs.	Skin, nose, uterus	14	1,370,000	42,000	7 min.	6 min.	None in 24 hrs.	+	B.P. 3rd day 64,000 5th day 516,000. B.T. 6½m. 9th day 105,000 15th day 400,000	No recurrence	2½ mos.	Good.
28	Giffin (13) Judd	F	18	C	Several years	Skin, nose, uterus, gums	15 to 71	1,800,000 to 4,200,000	22,000 to 7,000		3½ min. to 24 hrs.	?	?	B.P. 1st day 320,000 9th day 840,000	No recurrence	2 mos.	Good.
29	Giffin (13a) C. H. Mayo	M	27	C	8 mos.	Nose, skin	Normal	Normal	50,000	8½ min.	4 min.	Delayed	+	B.P. 8th day 360,000 13th day 504,000 3 wks. 308,000 B.T. 2 min.	No recurrence	3 mos.	Good.
30	Keisman (23) Lieblein	F	17	C	4 yrs.	Gums, stomach	40	2,400,000	4,500	?	?	?	?	B.P. 6 hrs. 220,000 6 mos. 240,000 R.B.C. 4,000,000 Hgb. 75%	6 mos. occasional nosebleed—1 yr. severe menorrhagia	1 yr.	Poor.
31	Herfarth (18)	M	19	C	7 yrs.	Nose, skin	35	3,100,000	30,000	?	23 min.	?	?	B.P. 1st d. 30,000 later 350,000	No recurrence	?	Good.
32	Herfarth (18)	F	23	C	3 yrs.	Nose, uterus	61	3,700,000	30,000	?	?	?	?	B.P. 10th day 180,000 3 mos. 344,000 B.T. 2 min. R.B.C. 4,400,000 Hgb. 58%	No recurrence	3 mos.	Good.
33	Cori (7) Eichenwald	F	13	C	4 yrs.	Nose, skin	90	4,700,000	0	?	?	?	?	B.P. 5 hrs. 109,000 13 days 740,000 10 mos. 145,000	No recurrence	10 mos.	Good.
34	Cori (7) Ranzi	F	21	C	9 yrs.	Nose, gums, uterus	40	4,200,000	2,700	?	?	None	?	B.P. 7 hrs. 63,000 10 days 1,100,000	Died on 29th day of a subphrenic abscess. No recurrence of bleeding		Died.
35	Hauke (16)	F	5	C	3 yrs.	Nose, stomach	15	1,300,000	800	?	36 min.	?	?	B.P. 2½ mos. 19,000 R.B.C. 6,700,000 Hgb. 62% B.P. 6 mos. 3,600 R.B.c. 4,600,000 Hgb. 81%	6 mos. only occasional petechiæ	6 mos.	Good.
36	Vogel (38)	M	12	A	7 yrs.	Nose, rectum, skin	?	?	25,000	?	90 min.	?	?	B.P. "shortly after op." no increase. 10 mos. 20,000 Bleeding time normal	No recurrence	10 mos.	Good.
37	Vogel (38)	F	17	C	1 yr.	Nose, uterus	?	?	None	Normal	25 sec.	?	?	B.P. 14 days 900,000 14 mos. 32,000	No recurrence	14 mos.	Good.

REPORTED CASES OF SPLENECTOMY FOR THROMBOCYTOPENIC PURPURA HÆMORRHAGICA—Continued

Case No.	Author Operator	Sex	Age	A = Acute C = Chronic	Duration of symptoms	Bleeding from or into	Hgb.	R.B.C.	Blood platelets B.P.	Clotting time	Bleeding time	Clot retraction	Hess' tourniquet test	Blood findings after splenectomy	Recurrence of symptoms	Follow-up interval	Result
38	Sternberg (35)	F	64	C	1 yr.	Skin	85	4,120,000	36,000	20 min.	20 min.	Slight	?	B.P. 24 hrs. 187,000 Bleeding time 1½ min.	Bleeding recurred in 2 mos.	2 mos.	Poor.
39	Wild (41)	M	15	C	15 yrs.	Skin	?	3,200,000	92,000	Normal	5 min.	?	?	B.P. 2 days 194,000 36 days 820,000 9 mos. 306,000	No recurrence	9 mos.	Good.
40	Herrman (19)	F	16	A	4 days	Nose, skin, uterus	60	2,500,000	None	?	?	?	?	Died a few hours after splenectomy	Autopsy showed subcutaneous, subserous and parenchymatous hæmorrhage		Died.
41	Engel (9)	F	22	C	9 yrs.	Skin, gums, uterus	35	2,120,000	19,000	?	?			1st day curettage for menorrhagia 2nd day transfusion B.P. 3rd day 230,000 Hgb. 50% 10 wks. 148,000 Hgb. 93% R.B.C. 4,500,000	No recurrence of bleeding after 2nd day	2½ mos.	Good.
42	Engel (9)	M	29	A	3 days	Skin, gums, kidneys, bowel, stomach	76	4,500,000	0	3½ min.	3 hrs.	Very long	?	Patient died 4 hours after operation	Autopsy showed hæmorrhages into skin and serous cavities, and necrosis of bone marrow		Died.
43	Engel (9)	M	44	A	3 days	Skin, kidney, bowel	44	2,210,000	90,000	4½ min.	?	?	?	Patient died 6 hours after operation	Autopsy showed hæmorrhages into gastro-intestinal tract, genito-urinary tract and heart. Tb. of lymph gl.		Died.
44	Engel (9)	F	17	A	10 days	Uterus, skin, gums	20	1,240,000	14,800	Normal	12 min.	?	?	B.P. 1st day 29,000 2nd day 115,000 12th day 101,000 3 mos. 176,000 Hgb. 70% R.B.C. 4,600,000	Severe nosebleed on 12th day. No recurrence of bleeding after that	3 mos.	Good.
45	Sutherland-Williams (36) Murray	F	8	C	?	Skin, nose	?	?	15,000	?	?	?	?	B.P. 26th day 180,000 3 mos. 30,000 5 mos. 120,000	Petechiæ and bruises still occur No external bleeding	8 mos.	Good.
46	Sutherland-Williamson (36) Murray	M	9	C	?	Skin, nose	?	?	5–8,000	?	?	?	?	B.P. 6th day 140,000 41st day 350,000 4 mos. 200,000	General health normal. No recurrence of bleeding	4 mos.	Good.
47	Hitzrot (48) Hitzrot	F	8	C	1 yr.	Skin, nose	40	2,400,000	40,000	6 min.	20 min.	None	?	B.P. rose after operation from 50,000 to 600,000. Bleeding time fell to less than 5 min.	Marked improvement. No recurrent bleeding	21 mos.	Good.
48	Henrahan (17)	F	46	C	6 mos.	Skin, uterus bowel	?	4,200,000	"Reduced"	7 min.	6 min.	None	?	Patient stood operation well but died 2 hours later	No autopsy		Died.
49	Henrahan (17)	F	21	C	18 mos.	Gums, uterus, skin	32	1,600,000	120,000	7 min.	17 min.	None	?	B.P. 1st day 120,000 18th day 160,000 Died on 30th day	Autopsy: furunculosis, abscesses in lung, myocardium, kidney		Died.
50	Vincent (37) Vincent	F	28	C	?	?	?	?	Very few	?	?	?	?	B.P. 7th day normal. Clotting time 8 min. Bleeding time 3 min. Clot retraction normal	No recurrence of bleeding or purpura	12 mos.	Good.

51	Vincent (37) Vincent	F	64	C	?	?	?	?	Very few	?	?	?	?	B.P. 3rd day normal. Clotting time 10 min. Bleeding time 7 min. Clot retraction normal	No recurrence of bleeding	10 mos.	Good.
52	Vincent (37) Vincent	F	13	C	?	?	?	?	Very few	?	?	?	?	B.P. 7th day above normal. Bleeding time 3 min. Clotting time 8½ min. Clot retraction normal	Slight nosebleed twice	8 mos.	Good.
53	Vincent (37) Brewster	F	14	C	?	?	?	?	Very few	?	?	?	?	B.P. 3rd day normal; 13th day ½ normal. Bleeding time and clot retraction normal	No recurrence of bleeding	7 mos.	Good.
54	Vincent (37) Brewster	F	6	C	6 mos.	?	?	?	None found	?	?	?	?	B.P. 8th day above normal. Bleeding time 3 min. Clotting time 4 min. Clot retraction normal	No recurrence of bleeding in hospital	No follow-up	?
55	Singleton (33)	F	49	C	6 mos.	Gums, skin	50	2,900,000	Very few	5 min.	15 min.	?	?	B.P. 10th day 180,000 22nd day none found 30th day 200,000 4 mos. 16,000 9 mos. 24,000	8 mos. readmitted with bleeding gums. 10 mos. after op. died of massive hæmorrhage into right ventricle of brain, also had bleeding from vagina, stomach, and gums		Died 10 mos. after op.
56	Cohn-Lehmann(6) Cohn	M	5½	C	4 mos.	Skin	55	3,700,000	?	4 min.	5 min.	?	?	B.P. 6 mos. 140,000 12 mos. 700,000	No recurrence of bleeding	12 mos.	Good.
57	Clopton (5) Clopton	F	Child	C	?	Skin, nose	?	?	Very few	4 min.	13–27 min.	None	?	B.P. 2 wks. 60,000 6 wks. 95,000 9 mos. 150,000 Bleeding time 2 min.	Slight bleeding for 6 mos. then stopped entirely	12 mos.	Fair.
58	Clopton (5) Clopton	F	Child	C	?	Skin, nose	?	?	Very few	4 min.	12–37 min.	None	?	B.P. 10th day 50,000 30th day 90,000 9 mos. 100,000 Bleeding time 2½ min.	Following a tonsillitis, bleeding recurred in severe form	12 mos.	Poor.
59	Clopton (5) Clopton	F	30	C	?	?	?	?	70,000	4 min.	8 min.	None	?	B. P. 2nd day 250,000 1 mo. 250,000	6 mos. No recurrence of bleeding	6 mos.	Good.
60	Moschowitz (27) Moschcowitz	?	?	?	?	?	?	?	?	?	?	?	?	B. P. doubled after operation	None	?	Good.
61	Waugh (39)	?	?	?	?	?	?	?	?	?	?	?	?	B.P. rose rapidly to 155,000	None	2 mos.	Good.
62	Schmidt (32)	?	?	C		Skin	?	?	Very low	Normal	?	None	?	B.P. markedly increased	None "cured"	?	"Cured"
63	Schmidt (32)	M	11	C		Skin, nose, mucous membranes	?	?	Very few	?	?	Delayed	?	B.P. markedly increased	Improved, epistaxes and petechiæ fewer	?	Fair.
64	Larabee (24)	?	?	C	?	?	?	?	?	?	?	?	?	?	Entirely relieved of symptoms	4 mos.	Good.
65	Lee (25) Lee	F	?	C		Skin, gums, uterus	?	?	20,000	4 min.	30 min.	None	?	B.P. 1st day 80,000 1 week 200,000	Continued to bleed from uterus; skin and gums negative. Patient died 2 weeks after op. Autopsy: neg. findings		Died.
66	Starr (34)	?	?	?		?	?	?	None	?	?	?	?	B.P. 1st day } few seen 3rd day }	Patient died of pachymeningitis hæmorrhagica. Autopsy: Massive clots found over both hemispheres beneath dura		Died.

REPORTED CASES OF SPLENECTOMY FOR THROMBOCYTOPENIC PURPURA HÆMORRHAGICA—Continued

Case No.	Author Operator	Sex	Age	A=Acute C=Chronic	Duration of symptoms	Bleeding from or into	Hgb.	R.B.C.	Blood platelets B.P.	Clotting time	Bleeding time	Clot retraction	Hess' tourniquet test	Blood findings after splenectomy	Recurrence of symptoms	Follow-up interval	Result
67	Flexner (11) Frank	F	15	A		Skin, uterus, gums	60	3,000,000	Very scarce	Normal	10–15 min.	?	?	Case reported immediately after	operation	No follow-up	
68	Bowen (3)	M	18	C		Skin	18 to 80	1,600,000 to 5,000,000	2,500	8 min.	20 min. to 2 hrs.	None	?	B.P. 2 hrs. 17,000 4 hrs. 22,000 24 hrs. 190,000 48 hrs. 230,000 9th d. 608,000 B.T. 3½ min. 4 mos. 85,000 B.T. 8 min.	No recurrence	4 mos.	Good.
69	Eylenburg (10) Muhsam	F	?	C		Uterus, skin	25	1,252,000	38,420	?	?	?	?	B.P. 3rd day 34,400 2 mos. 577,000	No recurrence	3 mos.	Good.
70	Rixford (30) Rixford	F	40	C		Uterus, skin, nose, gums	43	2,180,000	Almost none	Normal	Prolonged	None	?	B.P. 19th day 100,000 32nd day 167,000 R.B.C. 3,300,000 Hgb. 42%	Normal menses followed op. 2 mos. after op. she developed acute myelogenous leukæmia and died 4 mos. after op.		Poor.
71	Peterson (28) Peterson	M	6	C		Skin, nose	?	?	16,000	9 min.	Prolonged	?	+	B.P.	He developed hemiplegia on 10th day and died 13 days postop.		Died.
72	Ricaldoni-Albo (29)			R	eport a ca	se of chronic	p u r	pura hæm	orrhagica	"cu	red" b	y splen	ecto	my.			
73	Engel (9) V. A. Weth	F		R	eferred to	by Engel as c	ase o	f chronic p	urpura h	æmo	rrhagic	a with	sple	nectomy.	Result	not re	ported.
74	Engel (9) Vogel			R	eferred to	by Engel as a	case	of chronic	purpura	hæm	orrhag	ica wit	h spl	enectomy.	No i	mprov	ement.
75	Kaznelson (22) Minot			R	eferred to	by Kaznelson	as	an unpubl	ished cas	e.						No	result.
76	Kaznelson (22) Retzloff			R	eported	May 4, 1921,	Berl.	Medicin.	Gesellsch	.						No	result.
77	F. Sternberg (35) Adam	F	64	C		Uterus, skin	87	4,620,000	62,600		12 min.	None		B.T. 1½ m. B.T. 4 min. B.P. 24 hrs. 187,000 48 hrs. 78,000 20 day 130,000 2 mo. 103,000	No recurrence	2 mos.	Good.
78	Whipple (40) Whipple	M	18	C	4 yrs.	Nose, gums, skin	65	4,200,000	None found	3 min.	12 min.	None	+	B.P. 1st day 50,000 2nd day 80,000 3rd day 180,000 9th day 10,000 1 mo. 10,000	No recurrence. Can brush teeth without bleeding. B.T. 3 min. Clot retracts better than control. Playing baseball	4 mos.	Good.
79	Whipple (40) Whipple	F	47	C	Years	Skin, nose, gums	75	4,400,000	Less than 5,000	9 min.	8 min.	Delayed	?	B.P. 1st day 25 000 2nd day 30,000 6th day 100,000 B.T. 1⅓ min 8th day 30,000 3½ mos. 10,000 B.T. 18 min.	Occasional petechiæ, 1 nosebleed, some bleeding from gums. Feels much stronger.	3½ mos.	Fair.
80	Whipple (40) Whipple	F	25	C	Years	Skin, uterus	53	3,300,000	15,000	4 min.	4 min.	Delayed	−	B.P. 3rd day 35,000 5th day 65,000 6th day 40,000	No recurrence of bleeding. Post-op. massive lung collapse	Still in hospital	
81	Whipple (40)	F	42	A	4 weeks	Nose, skin, gums	50	3,000,000	4,000	6½ min.	8 min.	Delayed	−	Patient died in another hospital o	ne hour after operation.		

of the reticulo-endothelial system is localized to the spleen.

The acute fulmigating type usually gives no history of former petechiæ but there occurs sudden, severe, uncontrollable oozing of blood from mucous membranes and into the subcutaneous tissues and organs. Hæmatemesis, hæmaturia, blood in the stools, in severe form, are more apt to occur. These cases do not respond to one transfusion as promptly as do the chronic forms, but may require repeated transfusions before the bleeding stops. In one of the cases reported from the Mayo Clinic, 12 transfusions were given in 40 days. These cases should be tided over by transfusions until the bleeding has stopped and when built up, splenectomized to prevent a recurrence.

In the 81 cases collected there were 8 cases operated upon during the acute stage with 7 deaths—all within a very short time after the completion of the operation. Of the 73 cases of the chronic form, there were only 6 postoperative deaths, showing the relative safety of splenectomy in the chronic form.

There are certain features characteristic of the chronic type. The immediate return to normal bleeding time, the abrupt sharp rise of blood platelets to 200,000–600,000 with a sharp drop within 2 to 60 days to normal or a low figure, the clearing up of the muddy pallor, the disappearance of petechiæ and purpuric spots and cessation of bleeding from nose, gums, and uterus are the spectacular features. Perhaps the most important feature to the patient is the sense of well-being felt within a day or two.

Kaznelson's first case splenectomized in 1916 has had no recurrence of symptoms of any sort. He reports two more cases 6 years after operation, in one of which the result was good, in the other fair. Beneke reports a 5 year result with no recurrence. Ehrenberg reports a 4½ year result with no recurrence. Fourteen cases are reported that have gone a year or more without recurrence of symptoms.

Keisman reports one case 1 year after operation without improvement.

Clopton reports a poor result in a case 1 year after operation, the result of a tonsillar infection.

In a few cases there were later occasional nosebleeds and petechiæ.

Some of the cases were reported as having recurrences of petechiæ and purpuric spots following infections such as tonsillitis and influenza—supporting the etiological factor of infection.

Many of the cases followed showed a persistently low platelet count, although there had been no recurrence of symptoms.

Three cases have been reported as dying at intervals of 3 weeks to 18 months after splenectomy, from intracranial hæmorrhage.

SUMMARY

Of the 81 collected cases there were
- 73 of the chronic type
- 8 of the acute
- 6 deaths in the chronic varieties
- 7 of the 8 acute cases operated upon died

Of the 61 followed cases,
- 51 gave good results
- 4 fair
- 6 poor

Considering the brilliant immediate results and the restoring to normal living of the great majority of the cases of chronic purpura following splenectomy, it may be said that this operation has contributed the greatest advance to the therapy of the purpuras, but it must be remembered that these results are largely limited to the chronic variety. Furthermore, it should be emphasized that the patients after splenectomy should be cautioned and guarded against infections in order to obtain the best results.

AUTHOR'S CASES

CASE 78. A. V., age 18, was admitted to the hospital first July 28, 1920. His chief complaint was spots on the body, which appeared 4 days ago. The family history showed no hæmophilia or purpura. There is no history of exanthemata. Patient had pneumonia at 5 and again at 11. He has had no rheumatism or sore throats; occasional bronchitis. Five days before admission patient vomited three times. No blood. Four days before admission he noted many fine red spots on the feet and legs. The next day the spots were higher on the body and arms, and in the evening there were large ecchymoses on the body. The day before admission the urine was bright red. The findings on admission were epistaxis, bleeding gums, melæna, hæmaturia, and

purpuric eruption; no joint symptoms; no abdominal pain; fundi negative. The blood count showed 3,200,000 red cells, 12,200 white cells. The differential count was normal. Bleeding time 5 minutes, clotting time 25 minutes. No retraction of clot in 24 hours. The platelet count was 280,000. Wassermann reaction was negative. Patient belonged to blood Group I. The patient was relieved of all symptoms and signs noted on admission by transfusion of 350 cubic centimeters of citrated blood 1 week after admission. No other treatment was needed. He was discharged August 12, 1920, 5 days after transfusion, with red blood cells 4,680,000; hæmoglobin 84 per cent. Bleeding time 2 minutes; clotting time 6½ minutes; clot retractile.

Interval history. Patient attended school regularly and noticed no bleeding or tendency to bleed on trauma; no hæmaturia; no melæna.

Patient admitted second time, March 8, 1921. On the morning before admission, while dressing, he noted small spots on the legs similar to those noted in July, 1920; small purpuric vesicles on thighs, trunk, and in mouth; small eruptions on legs and bleeding from gums. He was given immediate transfusion of 250 cubic centimeters of citrated blood and two more of like amount during 2 months' stay in hospital. He had several nosebleeds and crops of purpuric spots. It was thought that oil of turpentine, minims xv, helped a little.

Patient was followed in out-patient department. He remained well and free from symptoms until June, 1923. The platelet count steadily rose to 50,000. Then he had a mild attack of nausea and purpuric eruption; platelets 10,000. He was sent home to bed and became entirely well in a few days.

He was admitted the third time, October 11, 1924. One month before admission he began to have bleeding from gums, melæna, purpuric eruption, nausea, etc. Treated for hæmophilia by injections of arsenic and iron. He has been in bed for past 3 weeks and feels very weak. The skin is waxy pale and there are many ecchymotic spots on the legs and body; the teeth are dark colored. The gums are bleeding. A soft systolic murmur is heard at apex. Red blood cells, 2,020,000; hæmoglobin, 23 per cent; achromia and stippling; white blood cells, 15,000; polynuclears, 76 per cent; platelets, less than 20,000. Bleeding time, 3½ minutes; no clot retraction. Vomitus and stools—guaiac 4 plus. Five transfusions were administered: the first of 1,000 cubic centimeters and the others of 500 cubic centimeters each, of unmodified blood, at weekly intervals. There was a gradual but steady improvement with a gain of 3 kilos in weight. Patient continued to have bleeding and eruptions from time to time, so he was advised to go to the country for 3 weeks and return for splenectomy. Red blood cells, 4,100,000; hæmoglobin, 85 per cent on discharge, December 3, 1924.

He was admitted the fourth time on December 26, 1924. A transfusion of 400 mils of unmodified blood was given on day of admission, without reaction. Red blood cells, 5,712,000. Hæmoglobin, 60 per cent; platelets, 0-600.

Operation: Splenectomy, December 27, 1924.

Patient had a good deal of shock for 1 day postoperative, and a rather marked fall of red blood cells to 3,960,000, but he soon rallied and has improved steadily ever since. Color is good. Purpuric eruptions have almost entirely cleared up. Bleeding time has come down from 11 minutes to 2 minutes. Can now brush teeth with only slight bleeding of gums, and no spontaneous bleeding. Platelet count as shown on graphic chart for 9 days postoperative is as follows:

	Day	Count
December 28, 1924	first	50,000
December 29, 1924	second	80,000
December 30, 1924	third	180,000
December 31, 1924	fourth	150,000
January 1, 1925	fifth	50,000
January 2, 1925	sixth	15,000
January 5, 1925	ninth	10,000
January 7, 1925	eleventh	30,000
January 9, 1925	thirteenth	60,000

Followed in clinic:

April 21, 1925: temperature, 98.6; respiration, 22; weight, 135. He feels all right, has no fatigue, can work and play as well as ever. There is no bleeding. He has gained 5¼ pounds in 6 weeks and looks perfectly well.

Hæmoglobin, 80 per cent; red blood cells, 5,088,000.

April 27, 1925, blood platelets, 10,000.

Follow-up—Six months after operation, 444; patient feels perfectly well, is active in athletics, has no further hæmorrhages or petechiæ; no bleeding on brushing his teeth. The scar is firm.

Twelve months after operation the boy feels well. The following month, a few petechiæ appeared over the lower extremities. Red blood cells, 4,700,000; hæmoglobin, 80 per cent; blood platelets, 5,000.

Case 79. C. T., age 47, Hist. No. 61775, May 7, 1925. An Italian language teacher, married, was admitted December 20, 1924, complaining of weakness for 3 weeks, and black and blue spots for 2 months. She had always been very well all her life except for some nosebleeds occasionally. Two months ago she began to have large black and blue spots all over her body, at first red, then black and blue, and then fading out. She also noticed many small red spots on her legs. Three weeks ago she started to have a nosebleed which persisted off and on and became much worse 4 days ago, and was associated with slight dyspnœa on exertion, and weakness. She gave no history of intestinal or gastric bleeding. Temperature, 99.8; pulse, 100; respirations, 24; blood pressure, 110-70.

Physical examination shows a well developed and nourished woman who appears quite ill. Variable sized ecchymoses are present all over her body; numerous petechiæ. The pupils are negative and react. The abdomen obese; the liver and spleen not felt; no tenderness. The extremities are negative;

no œdema is present. The knee jerks are equal and active.

Urine examination shows: albumen, 0; sugar, 0; frequent white blood cells, occasional red blood cells, at times. Wassermann negative. Red blood cells, 4,100,000, hæmoglobin, 95 per cent; white blood cells, 10,300; polynuclears, 59 per cent; leucocytes, 24; large mononuclears, 10; eosinophiles, 6. Red blood cells show slight variation in size and shape. White blood cells show occasional lymphocytes with coarsely granular cytoplasm. Platelets practically absent. Clotting time, 9 minutes, control 9; bleeding time, 8 minutes, control, 5 minutes. Stool is negative for blood. Patient was observed on the medical service for 3 weeks and then transferred for

Splenectomy, January 20, 1925. The spleen was two to three times larger than normal. Some adhesions were found along the lateral abdominal wall; a thickened lieno-renal ligament. Pathological report: Spleen uniformly enlarged with yellowish patches on capsule which microscopically prove to be old organized areas of purpuric hæmatomata. Diagnosis: purpura hæmorrhagica.

Patient did very well but had 2 severe nosebleeds, one 15 days after operation, the other 19 days after operation, at which time the blood platelets were very low. She was discharged February 16, 1925, in good condition. The platelets which were practically absent before operation gradually increased after operation, reaching a maximum in 6 days and then falling off. There was a leucocytosis following splenectomy. The platelet count after operation is as follows:

Day after operation	Platelets	
1st	25,000	No clumps
2nd	30,000	No clumps
3rd	45,000	1–2 clumps
4th	55,000	No clumps
5th	70,000	Few
6th	100,000	Several
7th	70,000	Few
8th	20,000	No clumps
20th	5,000	Practically absent

The white blood count after operation was as follows:

Day	White blood cells	Polynuclears	Leucocytes	Large mononuclears
1st	60,500	87	11	2
2nd	48,900	81	13	6
3rd	27,100	81	14	4
4th	27,000	77	20	3
6th	24,800	80	17	2
7th	26,700	85	10	5
8th	24,500	83	13	4
9th	92,400	86	10	4
9th	92,400	86	10	4
10th	27,600	80	14	2
20th	24,000	89	0	11

Bleeding time at operation was 8 minutes; 6 days postoperative, 1 minute, 30 seconds; 20 days, 3½ minutes.

Clotting time at operation was 9 minutes; 6 days postoperative, 5 minutes, 10 seconds; 20 days, 5½ minutes.

Follow-up: Two months after operation: Result: 4 3 4. Platelets 2½ months postoperative, 10,000. Bleeding time 2½ months postoperative, 18 minutes. Clotting time 2½ months postoperative, 7 minutes.

Follow-up, 6 months result: 444 feeling very well. No petechiæ. Blood platelets too few to count. Red blood cells, 4,500,000; hæmoglobin, 80 per cent.

Ten months, follow-up: 444 no bleeding of any kind. No petechiæ. Feels perfectly well. Red blood cells, 4,800,000; hæmoglobin, 83 per cent; blood platelets, 7,000; bleeding time, 2 minutes.

Case 80. A. V. History No. 62529. Readmission. The patient is a 25-year old Italian housewife, who was in the hospital for emergency treatment of a case of ulcerated, strangulated hæmorrhoids, the early part of April, 1925. She was discharged after 5 days, completely cured of this condition, the dilated, thrombosed veins having been clamped and ligatured. During the routine examination she was found to have a palpable spleen, which was enlarged almost a hand's breadth below the left costal margin, and as in her history there was made out a story of bruising easily, and a prolonged bleeding time for small cuts and the like, the splenomegaly was further investigated, and the following laboratory findings were reported:

Blood count: Red blood cells, 3,384,000; hæmoglobin, 53 per cent (Sahli); white blood cells, 10,900; polynuclears, 74 per cent; lymphocytes, 26 per cent.

Coagulation time, 4 minutes, control, 3½ minutes; bleeding time, 3½ minutes, control, ½ minute. Blood platelets: 15,000 in April; 20,000 in May.

She was followed in the out-patient department by Doctors Hanford and Whipple and although she was having no symptoms from her purpura hæmorrhagica (the diagnosis made on the above) she was advised to have her spleen out, and is readmitted for this operation.

Two days ago she coughed a little, and has had a slight dry cough during the day since then.

Physical examination. Temperature, 99.0; pulse, 86; respiration, 24. There has been no change since admission last month. Her color is the same dark-olive, and her features are more those of a negress than of an Italian. No petechiæ or ecchymoses are present. The eyeballs are prominent, and pupils react; the tongue is clean. There is no bleeding from the gums. The pharynx is negative, the tonsils are not enlarged or inflamed. The thyroid is not enlarged. The lungs are resonant throughout; no râles are heard. The heart is not enlarged; has regular sounds of good quality. Blood pressure is 130–70 (left arm). The abdomen is soft and not tender; no scars or herniæ; no tenderness. The spleen is quite definitely enlarged, about 7 to 8 centimeters below the left costal margin and extends a little anteriorly. Pelvic examination not made. There is no return of the hæmorrhoids, no anal tenderness.

Diagnosis: splenomegaly; secondary anæmia; purpura hæmorrhagica.

Operation: splenectomy for purpura hæmorrhagica.

Pathology: The spleen was about double its normal size. It was exceedingly friable and there were dense adhesions to the left leaf of the diaphragm. The separation of these resulted at one point in a difficult point of hæmostasis but hæmorrhage was completely controlled. The pedicle of the spleen was about normal in size in its relation to the pancreas. The gall bladder and duct system appeared normal as did the liver and stomach. The splenic vessels were not sclerotic.

A left rectus incision was made. The spleen was drawn to the midline and forward, its bed packed with roll of gauze, adhesions separated from the diaphragm and bleeding point controlled. Vessels and pedicle were ligated separately. After removing the spleen, inspection found hæmostasis to be good. Gauze packing was removed and closure done as follows: Posterior rectus sheath and peritoneum with chromic stitch, locked; anterior rectus sheath with continuous interrupted chromic; subcutaneous tissue and skin with silk on pearl buttons; skin with dermal.

Condition: good. Medication: none. Drains: none. Specimen: spleen.

Follow-up. After 3 months no recurrence of hæmorrhage. Periods regular and normal. Gums still bleed slightly when brushed.

Case 81. L. S., History No. 62638. American housewife of 42 was admitted to hospital complaining of epistaxis and bleeding from gums, beginning 4 weeks ago with a sudden profuse nosebleed, lasting 24 hours; a second nosebleed a week later; and 2 days before admission gums began to bleed profusely. She was sent in by the Dental Department for treatment of her general condition.

Patient's previous health has been good. She had a myomectomy and appendicectomy 9 years ago, and a complete hysterectomy 4 years ago.

Physical examination showed an obese white woman appearing chronically ill. Her skin was coffee colored and there were innumerable petechiæ, some as large as 5 and 6 millimeters in diameter, scattered over her body. There were several bloody crusts on her lips. There were hæmorrhagic areas on gums. The heart and lungs were negative. The spleen was palpable at the costal margin, not tender. The little finger of the left hand had an unusually large purple area near the nail, on admission.

Laboratory findings: Blood count, 3,000,000 red cells; hæmoglobin, 50 per cent; white blood cells, 13,800; polynuclears, 80 per cent. (On admission.) Blood platelets were practically absent, being counted as 4,000 and 2,000 on two occasions. Bleeding time, 8 minutes; clotting time, 6½ minutes. Blood Wassermann negative. Blood oxygen capacity hæmoglobin, 50.4 per cent. Stool showed guaiac 4 plus. There was slow retraction of the blood clot.

She was observed 1 week on the medical side running an irregular fever as high as 104.6 degrees. Herpes developed on lips but petechiæ faded and only a few fresh ones were formed. She was given a direct transfusion 300 cubic centimeters of unaltered blood and transferred with the idea of doing a splenectomy.

On admission to the Surgical Ward she developed a cough and for the first 4 days bled persistently from the nose which was not controllable by fibrinogen or other methods. The finger became very swollen and there was a marked subepithelial accumulation of blood. Her count fell to 1,050,000; hæmoglobin, 45 per cent. She was given an indirect transfusion—400 cubic centimeters of citrated blood, and after this she stopped bleeding, and for the past week has gradually improved with a clearing up of her cough and no further bleeding.

A week ago, however, she developed a right otitis media which was followed by a left otitis media, both drums being incised, and the X-rays of mastoid cells on the right was suggestive of pathology. This has also done well. Her bleeding stopped; her otitis cleared up, and she was discharged with the understanding that she return later for a splenectomy if symptoms returned.

A letter written to the surgeon in another hospital who had operated on the patient 2 weeks later gives the following information: The patient was operated upon on May 26, 1925, under ethylene anæsthesia. The spleen was found to be about 1½ times its normal size.

Operation: Splenectomy. Patient's condition at close of operation not very good; anæmia very perceptible. Patient's condition about 1 hour after operation was apparently good. Pulse had slowed down to 100. She had regained consciousness and complained of pain. Within ½ hour her condition changed rapidly. She became pulseless, respirations went down to 12, and she died within 30 minutes. No autopsy.

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A CLINICAL STUDY OF NEPHRITIS IN CASES OF PREGNANCY[1]

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THE literature on the toxæmia of pregnancy shows that the ideas of the obstetrician and the internist are frequently at variance. They do not use the same tests in searching for abnormalities of metabolism, nor the same language in describing them. Frequently patients dismissed by the obstetrician appear later in the consulting rooms of the internist with definite nephritis, and assert that it dates from the time of their last pregnancy. On the other hand, a patient may assure the internist that she had a very severe toxæmia during pregnancy, although there is no sign of residual damage. In view of this it seemed desirable to report a series of cases which had been closely observed in the clinic, either in the sections on medicine or obstetrics. In 1921 and 1922, 100 consecutive cases of renal damage occurring during pregnancy were chosen for study. All patients were included who showed signs of hypertension, œdema or renal injury during their present pregnancy, and all those with renal damage which was supposed to date back to a former pregnancy. Forty-three of this group who had pyelitis or pyelonephritis, will not be discussed in detail here. Recently questionnaires have been sent to all patients concerning their present condition, and the information thus obtained has been added to our records.

On the basis of the classification of Volhard and Fahr, these cases have been grouped as follows:

	Cases
A. Pyelitis and pyelonephritis	43
B. Hypertension and nephritis	57
I. Acute nephritis	
Acute glomerulonephritis	12
Acute nephrosis	2
Acute nephritis (unclassified)	1
II. Chronic nephritis	
Chronic glomerulonephritis	12
Chronic focal nephritis	10
Chronic nephritis (unclassified)	7
III. Sclerosis (vascular lesions)	
Benign hypertension	9
Malignant hypertension	4

ACUTE GLOMERULONEPHRITIS

Volhard has emphasized the resemblances between true eclampsia, so-called, and the convulsive form of uræmia. He also cites pregnancy as one of the causes of acute glomerulonephritis. He says: "but I see no possibility of differentiating, clinically, nephritis in pregnancy of unknown etiology from a specific nephritis in the non-pregnant woman"; and again, "the histological picture is those unhealed or chronic cases, which occur not infrequently, corresponds entirely to that seen in other cases of nephritis of chronic course, with special involvement of the small renal vessels in the form of endarteritis obliterans."

Fahr has examined the kidneys in twenty-eight cases of eclampsia, and believes that the lesion is a degenerative one, in the glomeruli, a "glomerulonephrosis." He also finds many hæmorrhagic casts in the tubules which he thinks account for the hæmaturia. He says: "The most important, and it appears to me the most constant change, is found in the walls of the glomerular capillaries. The change consists primarily of a broadening and swelling of the capillary wall which occurs to different degrees of intensity; many times it is only slight, scarcely to be noted; in other cases it is very marked, somewhat agglutinated so that many loops are matted together in an almost homogeneous mass, and the sharp cell outlines can no longer be recognized."

On the basis of his experience with nephritis among soldiers, and the nephritis of pregnancy, Heynemann also emphasizes the similarity in the clinical pictures. He believes that the main point of difference is the great tendency toward hæmaturia, frequently macroscopic,

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in the former, while in the latter it is either absent or evident only microscopically. Independently, one of us (Keith) suggested to Mussey the marked similarity of these two conditions. Mussey has reviewed the literature on the subject and has noted the close clinical similarity between a group of cases with pre-eclamptic toxæmia and acute glomerulonephritis. This clinical similarity raises the possibility of a common etiology.

The term glomerulonephritis must be used with a clear definition of its meaning. It does not necessarily mean a lesion without tubular disease, but rather a lesion that is primarily and chiefly limited to the glomeruli. Since the blood which reaches the tubules has first passed through the glomeruli, it is obvious that any toxin will first affect the glomeruli, but if it is of sufficient strength and acts for a sufficient length of time, it will eventually involve the tubules as well, and cause a diffuse nephritis. On the other hand, according to Volhard, the glomerular injury which can be demonstrated histologically is not proportional to the degree of toxæmia, and in an early stage may not be demonstrable microscopically.

The most important symptoms of glomerulonephritis are hypertension, œdema, and more or less hæmaturia. In mild cases, œdema may be present without hypertension and yet there will still be lesions in the glomeruli. More frequently the hypertension will be present with little or no œdema. Hæmaturi may be so scant and of such short duration that its detection is difficult. Other symptoms of nephritis, such as oliguria, albuminuria, cylindruria, dyspnœa, headaches, visual disturbances, or convulsions, may also be present.

Our twelve cases of acute glomerulonephritis were so classified because of the history of acute onset during pregnancy, the presence of hypertension and œdema, and the other signs of acute glomerulonephritis just enumerated.

The average age of the patients was twenty-three. Nine were primiparas. Œdema was present, while the patients were under our observation, in ten cases, and a history of earlier œdema was obtained in the other two. Of seventy-five blood-pressure readings on these patients, the average reading for systolic pressure was 151, and for diastolic 104 millimeters. The fundi were examined in ten; in six they were normal, while in four they showed pathological changes. Blood cells graded from 1 to 3 were found in the urine of five cases. The phenolsulphonephthalein readings averaged 38 per cent, while the blood urea averaged 34 milligrams for each 100 cubic centimeters. Volhard's water test was made in three cases; it was normal in two, but showed delayed excretion in the third. Five of the patients were delivered at the clinic; four children were normal and one was stillborn. The following cases are illustrative.

CASE 1. A primipara, aged 27, came to the Mayo Clinic September 9, 1921, 8 months' pregnant. Three months before, her legs had begun to swell, and 2 weeks before, the swelling had extended to her face. Her home physician had been examining her urine regularly, but found no albumin until 2 months before admission. There was marked œdema from the waist down, and the face was puffy. The systolic blood pressure was 152, and the diastolic 110; both persisted at about this level. There was albumin 4 in the urine, casts 3, and erythrocytes 1. The blood urea was 62 milligrams for each 100 cubic centimeters. The patient was delivered of twins September 10, and following this her symptoms rapidly cleared. She returned to the clinic June 22, 1922, three months' pregnant, for several days observation. Her blood pressure was normal; there was no œdema, and her urine never showed more than albumin 1; there were no casts or blood cells. Her urine was examined every 2 weeks until term, when she was delivered of a normal child without further trouble.

CASE 2. A primipara, aged 17, entered the Mayo Clinic September 22, 1921, in labor. She had noticed general œdema for about 1 month. The systolic blood pressure was 152, the diastolic 80, and the urine contained albumin 4 and a few casts. The blood urea was 26 milligrams for each 100 cubic centimeters. She was delivered of a normal child. About one-half hour after delivery, she had a slight convulsion and went into collapse, which seemed to be of cardiac origin, and about four hours after delivery, after a number of short convulsions, died. Necropsy showed marked diffuse nephritis, hypertrophy of the left ventricle and general obesity.

ACUTE NEPHROSIS

The term nephrosis has been used in a widely varying sense in the literature. Originally it was used by Mueller to denote degenerative, as opposed to inflammatory, changes in the kidney. Since this would in-

clude arteriosclerotic changes as well, Volhard further limited its use to primary degenerative changes. Typical examples usually given are the kidney seen in poisoning by bichloride of mercury and the amyloid kidney. By other authors the term is considered to mean a lesion limited to the tubules in contradistinction to one confined to the glomeruli. Others apply the term to a clinical syndrome characterized by massive œdema without hypertension and the urinary changes of nephritis, but with relatively good renal function, except for excretion of water and salts. Still others emphasize the low protein and high lipoid content which occurs in the serum in similar cases. Since part of these criteria are pathological and part clinical, it is obvious that no exact classification can be made until a larger series of cases has been studied from both standpoints.

We have used the term nephrosis to describe cases occurring in pregnancy in which, although considerable œdema and the urinary findings of nephritis were found, the blood pressure was normal and little disturbance of renal function was evident except for the excretion of salts and water. Heynemann has observed cases of massive œdema without significant urinary findings in soldiers at the time nephritis was prevalent. He believes that the famine type of œdema can be excluded in these cases since the patients were well-fed and well-nourished men. Two cases of this type are described.

CASE 3. A primipara, aged 21, came to the Mayo Clinic in labor April 1, 1921. Œdema was marked up to the knees, and the urine contained albumin 3, but no casts or blood cells, while the blood pressure and blood urea were normal. She was delivered of a healthy child. Since that time she has had three deliveries at the clinic without any recurrence of the renal symptoms.

CASE 4. A primipara, aged 21, came to the clinic December 29, 1921. The last menstruation occurred April 9, 1921. About 10 weeks before admission she had had quite a severe attack of diarrhœa, lasting about 5 weeks. About a month before admission she had noticed intermittent œdema of the legs and face. For the previous 2 days it had been persistent, and she had become quite dyspnœic. Her home physician had found albumin in the urine. Examination on admission showed œdema 2 of the legs, œdema 1 of the face, normal blood pressure, and albumin 4 in the urine. There were no casts or blood cells in the urine, and the blood urea was normal. The patient was delivered of a normal child January 5, 1922. By this time the œdema had practically disappeared. She returned to the clinic 4 months later for the extraction of teeth. On examination only albumin 1 was found in the urine, while the blood pressure was still normal; there was no further œdema.

ACUTE NEPHRITIS (UNCLASSIFIED)

One patient was seen with acute nephritis of pregnancy superimposed on an old pyelonephritis associated with bilateral choked disk. The lesion could not be satisfactorily placed in any group.

CHRONIC GLOMERULONEPHRITIS

Twelve cases were placed in this group. There was a history of acute onset with œdema during pregnancy, and at the time of admission to the clinic, at varying intervals after the pregnancy, chronic nephritis with hypertension was manifested together with a tendency to lowered renal function. Œdema was not necessarily present at the time of their admission.

The average age of the patients was thirty-four. The average blood pressure readings in this group were 189 systolic and 116 diastolic. The fundi were normal in three cases, while in nine there were signs of retinitis or vascular change. Blood cells were seen in the urine at the time of examination in six cases. The average of twenty-three tests with phenolsulphonephthalein was 33 per cent. The average of twenty-four blood urea tests in eleven cases was 119 milligrams for each 100 cubic centimeters. Water tests were made in five cases and were normal in two, while in three the excretion of water was delayed. In three cases the urine could not be concentrated well, while in two the power of concentration was normal.

CASE 5. A woman, aged 25, first came to the Mayo Clinic December 18, 1916. In January, 1914, when 4½ months' pregnant, the patient had influenza and threatened miscarriage. Her doctor found albumin in the urine at that time. Delivery was normal but she felt generally miserable and had a great deal of abdominal pain. The child died from convulsions in 3 weeks. At the time of her admission the blood pressure and renal function were normal, but albumin 2 and pus 3 were found in the urine, and culture of the urine for bacillus coli was positive. Cystoscopy was negative. She returned to the clinic

August 8, 1918. During the interval she had been pregnant and had been delivered 14 months before. The kidneys had caused further trouble during this pregnancy, but its exact type was unknown. The child was ill for some time after birth. The patient, when pregnant for the third time (7 months), came to the clinic because of general lassitude and swelling of the legs. The urine contained albumin 3 and pus cells from 2 to 4. The systolic blood pressure was 150 and the diastolic 90; the excretion of phenolsulphonephthalein was 40 per cent. The patient returned home and went through normal labor. She returned again to the clinic November 22, 1920. In the meantime she had been pregnant for a fourth time, and except for moderate œdema of the feet was well until her labor in July, 1920. About 40 hours after delivery she had had three convulsions, and following this felt fairly well. Her physician told her, however, that there was considerable albumin in the urine and that her blood pressure was high. On admission the systolic blood pressure was 195, and the diastolic 135; the excretion of phenolsulphonephthalein was reduced to 20 per cent, while the urine contained albumin 4, blood cells 1, and pus from 2 to 3, but no casts. The blood urea ranged from 88 to 128 milligrams for each 100 cubic centimeters. The culture of the urine showed staphylococcus and bacillus coli, but a second cystoscopic examination did not reveal a local lesion.

Renal function became progressively worse, the blood urea ranging from 344 to 422 milligrams for each 100 cubic centimeters, and the blood creatinin from 20 to 23 milligrams for each 100 cubic centimeters. The pyuria persisted; changes were observed in the fundus, and secondary anæmia appeared. The patient died July 4, 1922. Necropsy revealed advanced chronic glomerulonephritis and bilateral hydronephrosis, ascites, bilateral hydrothorax, anasarca, œdema of the intestinal wall, massive œdema of the lungs with early bronchopneumonia, subacute fibrinous pericarditis, and moderate myocardial hypertrophy and dilatation.

This case is somewhat atypical in two respects: first, the added presence of pyuria and infection with bacillus coli, and second, the presence of an infection at the onset of pregnancy. The more usual course is the persistence of the acute glomerular type without improvement, and with gradual impairment of renal function. The distinction between ordinary nephritis and pyelitis or pyelonephritis is usually quite sharp, but sometimes, as in this case, certain elements of each are combined.

CHRONIC FOCAL NEPHRITIS

According to Volhard, focal nephritis is caused by pathological changes in the kidney which are not sufficient to encroach on the margin of safety and lower renal function, and which are clinically unaccompanied by such general symptoms as hypertension or œdema.

No cases of acute focal nephritis were noted in this series. Such cases would present albumin, casts, and perhaps blood cells in the urine without general symptoms or signs of more extensive renal damage, or disturbance of renal function.

Ten cases were called chronic focal nephritis because only the urinary findings of nephritis were present, renal function being normal, and hypertension or cardiac hypertrophy and œdema being absent.

However, in eight of these ten cases there was a history of œdema during the onset in pregnancy, and although no definite history of hypertension could be obtained, it is probable that these cases were originally of the same group as the acute glomerulonephritic type, but had recovered to such an extent that only a focal residue persisted. Examination of the fundus was negative in six of these patients, while in one there were signs of old retinitis.

Case 6. A woman, aged 26, came to the clinic September 30, 1920, complaining of backache and dysmenorrhœa. Four years before, during her first pregnancy she had suffered from general œdema with albuminuria, and had given birth to a dead child. Three years before admission, during her second pregnancy, this trouble recurred, but the child was normal. Since that time the ankles had swollen a little in the afternoons. On the whole her health had been good. The urine contained albumin from 2 to 3, and an occasional pus cell and blood cell. The blood pressure, fundi, and renal function were normal. A year later she returned again to the clinic on account of dysmenorrhœa and her renal condition was apparently unchanged.

CHRONIC NEPHRITIS (UNCLASSIFIED)

Seven cases were placed in this group, largely because the patients were not available for a long enough study to make an exact classification possible. Hence this group does not argue against the accuracy of Volhard's grouping. The average systolic blood pressure in these cases was 174, and the average diastolic 115. The phenolsulphonephthalein tests averaged 31 per cent in twelve readings, and the blood urea 42 milligrams for

each 100 cubic centimeters of blood in seven readings. The fundi were negative in three cases and showed positive findings in three. In two cases there was a history of œdema. The average age of these patients was forty.

BENIGN HYPERTENSION

Adair, Mussey and Randall, and others have emphasized the importance of hypertension as an index of the toxæmia of pregnancy. The exact cause of hypertension is unknown. Allbutt, Volhard, and others have emphasized the importance of so-called benign or essential hypertension in which the blood pressure may be high for many years without disturbance of cardiac and renal function. The hypertension of pregnancy differs from the type ordinarily seen, in that it has a more acute onset and tends to disappear, in most cases, following delivery. In a certain percentage of cases, however, it persists after delivery and the patient may later come to the internist with typical persistent essential hypertension. These are the cases included in this group, and an illustrative one is described.

In considering the significance of the hypertension of pregnancy several points must be borne in mind: Volhard has shown that hypertension without œdema is seen in a considerable percentage of the cases of acute glomerulonephritis, and also that the hypertension may come on very rapidly in the course of a few hours in certain cases. This is one of the reasons he gives for postulating a vascular spasm of the arterioles as an important cause of acute glomerulonephritis. Keith and Thomson have shown in their studies of nephritis in soldiers that in many cases a good renal function was maintained. Thus acute glomerulonephritis without œdema and with good renal function would approximate clinically the hypertensive toxæmia of pregnancy, and the return of the hypertension to normal after delivery might be compared to the similar fall observed in cases of the nephritis of soldiers. Therefore, it is not impossible that the hypertension observed in pregnancy, including that which ceases as well as that which persists after delivery, may be only the early stage of the vascular lesion, which proceeding further can be associated with marked œdema and other symptoms of nephritis.

The average age of these nine patients was 32 years. Four were primiparas. Influenza and the intra-uterine presence of a dead fetus appeared to be predisposing causes in one case, while in four cases there was a definite history of convulsive attacks in pregnancy. In two cases slight œdema of cardiac origin was present. In twenty-three readings the average systolic blood pressure was 188, and the diastolic 117. The examination of the fundus was negative in five cases, but in three cases vascular changes or signs of old neuroretinitis were found. The renal function was good in all cases.

CASE 7. A woman, aged 26, first came to the Mayo clinic July 14, 1922, because of headaches and dizziness. In February, 1920, abortion had been performed because of placenta prævia. In November, 1921, during her second pregnancy she began to suffer from severe morning headaches with vomiting. Her home physician found the blood pressure, following her first attack of vomiting in February, 1922, to be 165. The urine contained only a slight trace of albumin at times and no blood. There were no chills, fever, or œdema. Abortion was performed in March. Following this the blood pressure decreased to 140, and she felt better until July, when it mounted to 170 and was accompanied by a recurrence of the headaches and dizziness. During two weeks in the hospital under our observation her blood remained at a systolic pressure of about 190, and a diastolic of 130. The highest systolic was 225, and the highest diastolic 150. The renal function was normal and the urine never contained more than albumin 1. There was slight reduction in the caliber of the retinal arteries while direct capillaroscopy showed that the capillaries were of the arteriosclerotic type and that their function was slightly disturbed. When last heard from, in December, 1924, she was again 3½ months' pregnant; the systolic blood pressure was 170, and the urine normal.

MALIGNANT HYPERTENSION

The term malignant hypertension is employed in the literature in two senses. Volhard and others use it to mean a benign hypertension in which the vascular lesion has progressed to involve the vessels of the kidney and thus cause secondary nephritis, while Wagener and Keith use it to apply to a group of cases in which the renal function is good but vascular, and retinal changes are very severe and diffuse, with death as a result of the general vascular lesion.

In the four cases which we have placed in this group, one was malignant in the sense of Volhard, while three were of the type described by Wagener and Keith.

Predisposing factors in these cases were convulsive toxæmia of pregnancy, typhoid fever, and a dead fetus in the uterus. In two there was slight œdema of cardiac origin. The average systolic blood pressure was 201, and the diastolic 127 of twenty-seven readings. Pathological changes were found in the fundi in three cases; the fourth was not examined. The renal function was good in three cases and poor in the fourth.

CASE 8 (Renal type of malignant hypertension). A woman, aged 46, entered the clinic May 5, 1921, because of œdema and dyspnœa. Eighteen years before, during her first pregnancy, she had suffered from toxæmia with seven convulsions, and her physician had found albumin and casts in her urine most of the time since. She had also had much trouble with severe headaches, nausea, and vomiting. There were two more uneventful pregnancies following the first, and she got along fairly well until the spring of 1919 when she had influenza and bronchopneumonia. Following this a certain amount of dyspnœa and slight œdema appeared. In January, 1921, she suffered from severe vomiting attacks, followed by marked dyspnœa and orthopnœa, together with occasional attacks of precordial pain. On admission she was very dyspnœic and showed considerable cyanosis, marked anasarca, ascites, and pulmonary congestion. The heart extended to the axilla, and the blood pressure throughout remained about 240 systolic and 110 diastolic. The fundi showed marked arterial changes with numerous exudates and a few small hæmorrhages. The urine contained albumin 1, but no casts and only an occasional erythrocyte. The phenolsulphonephthalein test showed no excretion of the dye while the blood urea varied from 130 to 170 milligrams for each 100 cubic centimeters and the blood creatinin from 8.6 to 8.8 milligrams. There was a rather marked secondary anæmia. Hæmoglobin was 55 per cent, and the erythrocytes numbered 2,740,000. The œdema and dyspnœa almost entirely disappeared with a Karell diet, digitalis, and diuretin. The patient returned home, but later the dyspnœa and œdema returned, and she died about two and one-half months afterward.

The differential diagnosis in this case of long standing glomerulonephritis following toxæmia and chronic hypertension with terminal nephritis is difficult to make here in the absence of postmortem examination. We have tentatively placed it in the group of malignant hypertension because of the long period of freedom from serious trouble, with the development of marked hypertension and retinitis with poor renal function, and the predominantly cardiac nature of her terminal dyspnœa and anasarca.

CASE 9 (Diffuse vascular type of malignant hypertension). A woman, aged 38, came to the clinic July 4, 1922, because of the high blood pressure. She had seven children living and well. With each of her pregnancies there had been œdema of the legs but no other symptoms. In the summer of 1921 a dead fetus was retained for 4 months and was delivered naturally at the eighth month. Since that time she had never regained her usual strength. She had been subject to migraine all her life, but after her last delivery the symptoms became more severe and almost continuous. In the late spring of 1922 she consulted an ophthalmologist for failing vision which had been coming on for 5 or 6 years. He told her she was suffering from retinitis and sent her to a physician who found the blood pressure increased. Since then the systolic pressure has varied between 180 and 200, in spite of the use of nitrites and iodides. On her admission the heart was moderately hypertrophied and the peripheral arteries thickened, while the vascular changes of hypertension with a few hæmorrhages and one exudate were evident in the fundi. The systolic blood pressure on admission was 240, and the diastolic 120. With rest and nitrites they were reduced to 150 and 90. The blood urea, the phenolsulphonephthalein, the water and concentration tests were negative. There was pus 1 in the urine, and the culture of the urine for bacillus coli was positive. Two and one-half years later she reports fair health.

TIME OF ONSET OF NEPHRITIS IN PREGNANCY

Other points of interest have been raised in the literature, on which our statistics have some bearing. Primiparas are supposed to be particularly predisposed to the nephropathy of pregnancy. Our statistics show the number of pregnancies as follows: I-para, 32; II-para, 7; III-para, 5; IV-para, 4; V-para, 2; VI-, VIII-, X-, and XIV-para, one each, and none for VII- and IX-para.

In two cases the disease antedated pregnancy but was aggravated by it. In this connection the numerical preponderance of primiparas over multiparas must also be taken into consideration.

The time in relation to pregnancy when the onset of symptoms appeared, is given in cases in which it could be ascertained: before pregnancy, 2 cases; first month, none; second month, 3; third month, none; fourth month, 4; fifth

month, 2; sixth month, 3; seventh month, 7; eighth month, 7; ninth month, one, and postpartum, one.

FOCAL INFECTION

Focal infection is often discussed in connection with nephritis of all kinds. Table I shows results of the examination of 54 of the 100 cases in this series. The cases of pyelonephritis thus share in the figures of focal infection. Since there was no significant difference between the two groups of nephritis, we have put them together. We have also tabulated from the history previous infections which might have been partly responsible for the renal damage. Facts in this connection were available in 87 cases. As a control group we secured the same data on the same number of normal pregnant women who were delivered at the Mayo Clinic during the same period as our original group.

TABLE I.—NEPHRITIS

	Patients	Controls
Previous infections		
Diphtheria	6	8
Scarlet fever	22	17
Pneumonia	19	16
Typhoid fever	9	4
Influenza	38	47
Tonsillitis	42	44
Rheumatic fever	7	5
Pleurisy	6	6
Malaria	3	0
Focal infections by patients		
Dental sepsis	25	27
Tonsillar sepsis	6	2
Both dental and tonsillar sepsis	7	16
Sinusitis	1	1
No foci	15	2

Focal infections were slightly more common in the control group, but it must be remembered that it is the type of organism rather than the type of focus which is apparently of most importance. In spite of considerable discussion in the literature, of the possibility of the nephritic symptoms of the toxæmias of pregnancy being exacerbations of pre-existing chronic nephritis, we were unable to get a history suggestive of preceding nephritis in more than two.

FATE OF THE CHILD

The fate of the child in these cases is of interest (Table II). Since the history in some cases covers several pregnancies, we have taken the results of all pregnancies in all mothers. This method tends to minimize somewhat the mortality directly due to the renal lesion.

TABLE II.—FATE OF CHILDREN

Diagnosis	Patients	Children	Miscarriage	Stillbirth or premature	Induced abortion	Ectopic	Percentage of living children
Acute glomerulonephritis	12	15	2	3			75
Acute nephrosis and acute nephritis (unclassified)	3	5					100
Chronic focal nephritis	10	29		2	2		88
Chronic glomerulonephritis	12	16	11	4	1		50
Benign hypertension	9	8	6	1	1	1	47
Malignant hypertension	4	13	4	1			72
Chronic nephritis (unclassified)	7	17	5	3			68
Total	57	103	28	14	4	1	
Average							68

THE END-RESULTS OF NEPHRITIS OF PREGNANCY

The end-results of our series from 2½ to 3½ years after admission are shown in Table III. Forty of the fifty-six patients were traced. The state of health which is given as a basis of classification is based on the patients' general statements as well as on the more specific data furnished in the questionnaires on blood pressure, urinalyses, and so forth. Some of the patients were re-examined at the clinic.

Since advice against further pregnancy was given in most cases, few further pregnancies are reported. One patient had two miscarriages; one had three normal children, and four others had normal pregnancies.

The end-results show that the mortality is high, approximately 25 per cent. The point of greatest interest is the prognostic significance which is revealed when the cases are grouped according to the Volhard classification at the time of examination. In cases diagnosed as focal nephritis, benign hypertension, and nephrosis, the patients recovered for the most part with little residual disease. The groups called chronic glomerulonephritis, malignant hypertension, and chronic nephritis (unclassified) show a high mortality. This is particu-

larly true of the group of chronic glomerulonephritis.

TABLE III.—END-RESULTS OF NEPHRITIS OF PREGNANCY

Diagnosis	Number Cases reported		Health			
			Good	Fair	Poor	Dead
Acute glomerulonephritis	12	8	4	2	1	1
Acute nephrosis	2	2	1	1		
Acute nephritis (unclassified)	1	1	1			
Chronic focal nephritis	10	4	3	1		
Chronic glomerulonephritis	12	12		5	2	5
Benign hypertension	9	7	2	2	2	1
Malignant hypertension	4	3		1	1	1
Chronic nephritis (unclassified)	7	4	1		1	2
Total	57	41	12	12	7	10

DISCUSSION

We have shown that the nephropathy of pregnancy and its sequelæ can be classified clinically into the same groups as that of the ordinary type of nephritis. We have disregarded so-called true eclampsia, in which at necropsy pathological change is found only in the liver, if at all. Harris has recently reviewed 177 cases of toxæmia of pregnancy from the Johns Hopkins Hospital. Fourteen of the patients died, and of the remainder 111 returned for further study at the end of one year. The condition was classified into three groups: eclamptic toxæmia, pre-eclamptic toxæmia, and nephritic toxæmia. Of twenty-seven patients with eclampsia seen a year later, three had chronic nephritis. Of 55 patients with pre-eclamptic toxæmia, 60 per cent suffered from chronic nephritis the following year, and all of the 30 patients whose cases were diagnosed as nephritic toxæmia now suffer from chronic nephritis. The larger percentage of residual chronic nephritis in all three groups suggests that the classification is more or less of an arbitrary one and that the fundamental process in all groups is similar.

The more modern tendency seems to be to consider nephritis as a systemic disease rather than as one limited exclusively to the kidneys. No plausible explanation of the symptoms of œdema and hypertension has been advanced when only pathological changes in the kidney have been considered, but when extensive lesions of the smaller blood vessels, capillaries, or general body tissues are postulated, these phenomena become much more understandable.

The vascular changes can be demonstrated clinically in the small vessels of the eye and by direct capillaroscopy in the nail-fold. Brown and Roth have called attention to a possible toxic lesion of the bone marrow that causes anæmia. Dunn and McNee have shown similar lesions about the vessels of the brain and spleen. With such a widespread vascular involvement it is no wonder that the small vessels and capillary tufts of the glomeruli are seriously damaged and it is in the kidney especially that such damage has disastrous effects on renal function. Similar vascular injury in the liver would pass unnoticed because of the wide margin of safety which must be overcome before symptoms of hepatic insufficiency are manifest, and because of its marked power of regeneration. Perhaps some of the more modern tests of hepatic function will reveal evidence of hepatic damage in nephritis.

A similar state of affairs apparently exists in the toxæmias of pregnancy. Hinselmann has recently shown that in eclampsia capillaroscopy reveals capillary changes which gradually return to normal in the course of several months, but that if chronic nephritis develops, these changes are more marked and permanent. These observations were later confirmed by Nevermann, Baer, Baer and Reis, Linzenmeier, and Hinselmann, Nettekoven and Silberbach. The last mentioned authors found changes in capillary circulation in 80 per cent of twenty-five cases of eclampsia; they consisted of structural changes and alteration of flow. Baer found normal capillaries in normal pregnancies. The presence of œdema, hypertension, and abnormalities in the eye-grounds, as well as renal changes, illustrates the diffuse nature of the process. Cheney has recently reviewed the literature and discussed the incidence of retinitis in the toxæmias of pregnancy.

If we assume the existence of a diffuse toxin that attacks the vascular system, which in nephritis seems to be often bacterial in origin, we can postulate different degrees of damage, depending on the potency of the

toxin and its localization. Acute glomerulonephritis may occur with or without œdema (18). It would be possible to have marked damage of capillaries or tissues with œdema and no hypertension and good general renal function (nephrosis). If the lesion extended from the glomeruli to the tubules, it would take the form of the combined glomerulonephritic and nephrotic form of Volhard. If the lesion healed with little remaining damage, the disease would then be chronic focal nephritis with good renal function. If the brunt of the attack was borne by the vessels rather than by the finer capillaries and the kidney, the result would be residual benign hypertension. If the vascular involvement slowly progresses to involve the finer vessels of the kidney, malignant hypertension in the sense of Volhard would be the consequence, and if the vascular degeneration was extreme and slowly progressive it would take the form of malignant hypertension described by Wagener and Keith, with adequate renal function.

A similar course of events might be postulated in pregnancy. The source and nature of the toxin are entirely unknown, although many explanations have been advanced. If the toxin acts chiefly on the liver it would cause that type of eclampsia which is associated with hepatic degeneration. Commonly it is more diffuse and widespread in its action, and a series of clinical pictures is produced which is very similar to those seen in nephritis.

SUMMARY

Many of the toxæmias of pregnancy are associated with nephritis and can be classified as are other types of nephritis, not necessarily occurring in pregnancy. The classification of Volhard and Fahr is followed.

The course of fifty-seven cases during pregnancy is followed, together with the fate of the mother and child over a period of 3 years.

Both nephritis and toxæmia of pregnancy seem to be general diseases affecting the cardiorenal vascular system as a whole.

When the toxæmia of pregnancy is classified by the same method which Volhard uses for nephritis, a marked difference in the end-results is seen and this difference allows the physican to make a more accurate prognosis, both as to the mortality among the mothers and as to the fate of the child in subsequent pregnancies.

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VOLVULUS OF THE CÆCUM

Report of a Case Complicating Typhoid

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VOLVULUS of the cæcum is of sufficient rarity to justify the publication of all undoubted cases. The developmental anomaly that causes it, together with its dramatic onset and unusual interest at the time of operation, all join in placing it a little outside the common run of surgical work.

In 1898, von Manteuffel collected 24 cases; in 1902, Faltin increased this number to 79, and in 1913 the number was raised by Bundschuh to 110. Bundschuh did not include five of Faltin's cases since they were associated with incarcerated hernia or invagination. A few others were not included; among them, cases published by Corner and Sargent. A number of cases have been reported since 1913, those by Beeger, Jacobsen, Homans, and Öhman being among the more recent.

It is generally conceded that a mobile cæcum is necessary to the production of volvulus. This anomaly of development is described by Gray as follows:

"After the third month of fetal life, the lower arm of the umbilical loop, which becomes the cæcum and colon begins to pass over the upper arm, which later becomes the duodenum and small intestine.

"The cæcum, which has already developed an appendix thus comes to lie up under the liver. The cæcum increases in length and, finding least resistance below, finally settles in the right iliac fossa, dragging down a short ascending colon. The mesentery of the cæcum and ascending colon usually disappears, and fusion of the posterior wall of the colon to the posterior abdominal wall takes place. Occasionally, however, the cæcum and ascending colon retain a more or less distinct mesentery."

In speaking of volvulus, Moynihan says "The sigmoid flexure is most commonly affected, but the ileum, jejunum, or cæcum may also be separately or conjointly involved. . . . In the majority of cases some anatomical abnormality is the determining factor—such as the cæcum and ascending colon suspended by a mesentery continuous with the mesentery of the small intestine."

Von Thun states that in the infant, mobile cæcum is sometimes due to a retardation in development; in elderly persons, to a general feebleness of the organs; and in the adult, to a sort of arrest of development or, as mentioned by Rovsing, to general enteroptosis.

In addition to the anatomical abnormality mentioned by most authors, Corner and Sargent discuss in some detail what they call an acquired volvulus. This they consider to be present in rotation of the cæcum on its long axis. The cæcum, in fetal form, is tapered. It takes on, at times, however, a pouched form and this form when distended or subject to contraction of the abdominal muscles is very liable to twist.

Other predisposing causes are:

1. Old scar formation and chronic mesenteritis (Philipowicz, Kuettner, Robinson).
2. Former operation (Whiting, Riedel, Huebner, Schultze, Robinson, Shepard).
3. Hernia (Rokitansky, Vaughan).
4. Fibrous bands (Tesson).
5. Mesenteric cysts (Huebner, Fertig).
6. Habitual constipation and chronic intestinal stasis with traction on mesentery (Bosquette, Delore).

Faltin who found a higher proportion of cases in Finland and Russia, believed the dietary customs of these two countries to be a predisposing factor. The vegetable diet of the Russians, together with the great number of feast days (120), bring about dilatation and atony, while in Finland the diet, consisting mostly of potatoes and sour bread, is in the same category.

The rotation of the intestine is of three types:

I. Circular rotation with one fixed point. The mesentery is common to the whole of the small intestine, the cæcum, and part of the colon. The root of the mesentery is thus much smaller and less widely spread. The axis may

be considered to be the superior mesenteric vessels, and it is around these vessels that the rotation takes place.

II. Elliptical rotation, two fixed points. Here the mesentery extends to the right iliac fossa in a lesser degree than normal. The mesentery of the lower part of the ileum is relatively shorter than that of the rest of the small intestine or cæcum and thus furnishes a second point for rotation.

III. Axial rotation. This is rotation of the cæcum on its long axis. It is always present in Types I and II but may exist alone. Types I and II are always associated with a congenital abnormality of the mesentery, while Type III may or may not be. When, however, the cæcum thus twisted is pouched the volvulus is purely acquired, since the pouching is acquired.

The direction of the twist is generally hard to define. Clockwise and counter-clockwise mean little unless the position of the watch is given. Homans states that in his one proven case it was clockwise looking downward; Tanner, that his was clockwise looking upward; in other words, the opposite to Homans. Beeger considers that the only way to determine the rotation is with the watch lying upon the patient's abdomen. Twist from right to left or left to right, right or left spiral, are equally confusing since the patient's left or right is opposite to that of a person facing the patient. Because of this confusion in descriptive terms it is impossible to classify the cases in the literature as to direction of the volvulus.

The most frequent location of the volvulus is in the left hypochondrium, being found there in 13 out of 33 cases in one compilation. It was also found in the right lumbar region, right hypochondrium, epigastrium, left lumbar region, left iliac region, umbilical region, pelvis, and in a right inguinal hernia sac.

Men are much more subject to volvulus than women. Of the 79 cases assembled by Faltin, 56 (70.88 per cent) were men; 23 (29.11 per cent) women. In the 57 cases reviewed by Corner and Sargent, 42 were in men and 13 in women. In 2 cases the sex was not mentioned. In the 110 cases reviewed by Bundschuh, 76 were in men, 31 in women, and in 3 the sex was not mentioned. Based on these figures about 70 per cent of the cases are found in men.

Volvulus is typically a disease of younger adult life, 45.44 per cent of all cases occurring between 17 and 30 years, and 71.4 per cent in patients less than 41 years, according to Faltin. Half of the cases were between 20 and 40 years in Corner and Sargent's collection; the youngest was 19 days old, the oldest over 70 years. Of Bundschuh's cases, 105 mention age; 82 were under 40 years, 20 over.

The symptoms of volvulus are those of strangulation or obturation ileus, and for this reason definite diagnosis is seldom if ever made. The most frequent symptoms, according to Beeger, are attacks of pain, vomiting, distention of the abdomen, no stools or flatus. These are all symptoms of strangulation ileus. Jankowski is quoted as stating that an enema of no more than three-quarters of a liter can be given with volvulus of the sigmoid flexure but that over two liters could be given with volvulus of the cæcum. In only 4 out of 77 cases did Beeger find that he could administer more than two liters, indicating that it is probably of little diagnostic value.

Volvulus may or may not be preceded by attacks of intestinal occlusion. Beeger found that of 67 cases assembled by him there were 28 with complete volvulus (42 per cent) who had never previously had any intestinal trouble. Faltin found that in 27 cases out of 79 the volvulus appeared very suddenly in the night during sleep. Thirty of his cases had complained of previous pain, 8 merely of sluggish bowel or colic-like pain, 22 had had one or more similar attacks.

External elements are occasionally precipitating factors. In 12 out of 46 acute cases, Beeger found the following mentioned:

	Cases
Heavy lifting	5
Trauma	1
Excessive eating of food causing flatulence	2
Food causing flatulence followed by violent exercise	1
Pregnancy	2
Postoperative uterus extirpation	1

In addition to the above, Faltin found that in two of his cases the volvulus was caused by forceful reposition of a strangulated hernia.

Treatment varies from resection of the affected bowel, if it is gangrenous, to simple

detorsion. If the greater part of the small intestine is involved in the volvulus, detorsion alone can be performed, since resection would be impossible. Beeger has outlined his treatment as follows: light attacks, detorsion; medium attacks, detorsion, resection of the gangrenous portions, entero-anastomosis; difficult cases, detorsion and enterostomy.

Detorsion with fixation of the cæcum, mentioned by Faltin, is, according to Beeger, no longer employed. Faltin stated that if fixation were not employed there was apt to be a recurrence and that there were some cases on record where a patient had had two or more operations for volvulus. Hartung, on the other hand, considers it as required in all cases where resection does not follow detorsion. Jacobsen recommends it if needed. Tanner employed it to good effect in his own case.

Bundschuh has tabulated the results of treatment in his 110 cases with the following results:

Of 23 patients not operated upon, all died.

Of 87 patients operated upon, 35 (40 per cent) recovered, 52 died.

Of 15 patients operated upon, no detorsion was performed, all died. (In some, enterostomy, typhlostomy, or anus præternaturalis.)

In 40 cases operation consisted only of detorsion and separation of adhesions, and 26 patients recovered (64 per cent).

In 1 case appendectomy, was performed after detorsion; death resulted.

In 9 cases, intestinal fistulæ were employed after the detorsion (7 typhlostomies, 1 ileostomy, 1 appendicostomy); all patients died.

In 4 cases typhlostomy was employed 2 days after the detorsion; 3 recoveries.

Partial resection of the gangrenous part of the intestine was made in three cases; all died.

Total resection of the involved part of the intestine was made in 15 cases; 7 recoveries (47 per cent).

There was thus 100 per cent fatality when no detorsion was attempted.

Simple detorsion of the volvulus sufficed in the cases in which early operation was possible or in which there had not been an acute course, i. e., in which the intestine showed little injury; 36 per cent mortality in these cases seems to Bundschuh to be high. The cause of death was frequently collapse, once pneumonia, often peritonitis. The prognosis following detorsion and enterostomy was very poor. All 10 patients who had primary enterostomies died, some in collapse, 1 of pneumonia, and 6 of peritonitis. Resection of the entire twisted section of intestine gave a much better prognosis (47 per cent recovered), though these were the poorest cases, all showing signs of gangrene and some of poor general condition. Of these cases, five died in collapse, two of pneumonia, and one apparently of peritonitis.

The conclusion is that in cases in which the intestine is in good condition, detorsion, with cæcopexy, if necessary, is sufficient. In cases of gangrene, complete resection is indicated unless a very large portion of the small intestine is involved. If immediate resection cannot be undertaken the entire twisted loop should be brought forward and resected when the patient has improved.

Enterostomy, anus præternaturalis, or suture of the appendix in the abdominal wall and opening of it is inadvisable if there is a possibility of gangrene, since in these cases perforation peritonitis cannot be prevented.

The general mortality in operative cases was 52.5 per cent in Corner and Sargent's compilation; without operation it was 66 per cent. In Beeger's 69 cases operated upon, the mortality was 53.6 per cent, and in Faltin's 79 operative cases it was 64 per cent.

My own case, the report of which follows, is unique in that the volvulus was a complication of typhoid. No such similar case was found in the literature consulted.

J. W., age 44, Hosp. No. 15616, service of Dr. T. C. Guenther. Patient was admitted to Norwegian Hospital, December 31, 1924, with a history of illness lasting 2 weeks. The chief symptoms had been headache, malaise, and epistaxis at the onset. His temperature on admission was 104 degrees; pulse, 100; respirations, 20. A blood count showed: red cells, 3,400,000; hæmoglobin, 63 per cent; polynuclears, 65 per cent; small lymphocytes, 28 per cent; large lymphocytes, 7 per cent. The Widal reaction was positive. The urine showed a trace of albumin. Physical examination showed rose spots, slight abdominal distention, and an enlargement of liver and spleen, both of which were palpable.

On January 5, 1925, there was impaired resonance over the upper left lung and râles were heard.

On January 9, 9 days after admission and during the third week of his illness, he complained of a severe pain in the right lower quadrant of the abdomen. His temperature, which had steadily remained above 102 degrees, immediately dropped to 97 degrees and the pulse dropped from 100 to 80 per minute.

Before the onset of pain there was only slight abdominal distention but within 12 hours this became quite marked. A blood count now showed 10,200 white cells and 80 per cent polynuclears. He was covered with a cold, clammy sweat and the pulse became small and thready. The pain was intermittent in character. When present it was very intense but relief was almost complete in the intervals between paroxysms.

A surgical consultation was now requested. When seen at 2 p.m. this patient did not impress one as being acutely and dangerously ill. His face was placid and the pain had temporarily ceased. The abdomen was moderately distended but was not tender or rigid anywhere. In fact the abdominal wall seemed flaccid. An indefinite resistance was felt across the lower abdomen giving the impression of cord-like loops of intestine. The picture was not that of a perforation. The pain was that of an obstruction, but why should an obstruction occur in the third week of typhoid?

It was considered advisable to wait a few hours longer, but a second blood count showed 10,600 white cells and a polynuclear rise to 93 per cent. A provisional diagnosis of a walled-off perforation with obstruction was made. Operation was done by the author, and was carried out entirely under local anæsthesia—0.5 per cent novocain being used.

Through a 6-inch incision from umbilicus to symphysis, an examination was made. An enormous coil of dilated large bowel was found filling the pelvis. The size was that of an ordinary muskmelon. After considerable study it was shown to be a huge cæcum which was entirely loose and free from attachment to the posterior abdominal wall well up to the hepatic angle. This had rotated a half turn causing the ileum to pass anteriorly and come to lie on the outer side of the cæcum and enter it from the right instead of from the left. Rotation clockwise looking vertically downward from head to foot. The volvulus was untwisted. A needle was passed through the base of the appendix into the cæcum and, by means of a suction pump, the air which was causing the great distention was removed, a purse string was inserted, the infected appendix removed, and the stump buried.

To prevent a recurrence of the volvulus, the anterior longitudinal band was sutured to the anterior abdominal wall. No perforation was present. The suturing was done in layers, and no drainage used.

On the day following operation the patient seemed improved. His bowels moved well and a large amount of flatus was expelled. In the afternoon he had a chill and the temperature rose to 105 degrees, pulse to 130, and respirations to 50. There was slight dullness in the lower left chest posteriorly with fine crackling râles. Moist râles were present in the axilla and anteriorly. Heart sounds were poor—hardly perceptible. The bowels moved in response to enemata. Flatus was passed. There was occasional vomiting.

On the second day following operation, the entire chest was full of moist râles, the pulse became imperceptible, and the patient died. In my opinion this patient died of pneumonia. Please note, however, that it was not an ether or gas pneumonia because no general anæsthetic was used. A postmortem examination was refused.

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CANCER OF THE UMBILICUS SECONDARY TO CANCER OF THE CÆCUM

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THE present case of metastatic malignancy of the umbilicus secondary to adenocarcinoma of the cæcum is reported because it is an instance of a rare condition and also because it serves to emphasize the importance of the navel as a mirror of the intraperitoneal pathological condition.

Cancer of the cæcum with metastases to the peritoneum, umbilicus, and skin, S. W. G. H. S. No. 1649. Mrs. R., a Norwegian American housewife of 65 years, entered the hospital February 18, 1925, complaining of abdominal pain, vomiting, and constipation.

The family and past histories were essentially negative with the exception of the fact that for many years she had been troubled with epigastric distress and gaseous and sour eructations coming on shortly after meals.

She dated her present illness from 2 years before entrance at which time she began to have pain across the lower abdomen. Two weeks after the onset of the pain she called her physician who made a diagnosis of acute appendicitis and advised immediate operation. Exploration revealed a distended small bowel and an inoperable tumor of the cæcum. Since that date she had been gradually losing weight and strength and becoming more and more constipated. The pain in the right lower quadrant had persisted and grown worse.

About a year after the onset of her trouble she noticed a small pimple at the umbilicus which bled when it was scratched. It continued to increase in size and at entrance was a raised, ulcerated fungating growth 6 centimeters in diameter.

Two days before entrance to the Wisconsin General Hospital she was taken with a severe cramplike pain in the lower abdomen. She vomited several times during that day and the next and only by repeated enemata was she able to accomplish any movement of her bowels. The day of entrance she became decidedly worse, vomiting and wretching every few minutes. On entrance to the hospital the vomiting had stopped and she felt much better. The vomitus had never been fæcal.

Physical examination showed evidence of considerable recent loss of weight. The liver was easily palpable. In the right lower quadrant of the abdomen was a hard irregular tumor, about 15 by 7 centimeters, which seemed to be attached to the anterior abdominal wall. The umbilical scar was replaced by a dark purplish red fungating tumor 5 centimeters in diameter and raised 1 centimeter above the skin surface. In the skin 1 centimeter below this and slightly to the right was a hard nodule 1 centimeter in diameter.

Microscopic examination of the tissue removed from the umbilical tumor showed it to be a typical adenocarcinoma. *Barium enema* revealed an irregular annular constriction of the cæcum. The plate also showed suggestive shadows of gall stones.

Operation. Ileostomy was performed February 21, 1925, by Dr. C. A. Hedblom.

A midline suprapubic incision was made. There was a moderate amount of free serous fluid in the peritoneal cavity. A very much dilated and hypertrophied loop of small bowel presented. There was a carcinomatous nodule on the peritoneum just to one side of the incision between the pubis and umbilicus. Exploration showed a large mass in the ascending colon which was adherent to the parietal peritoneum. The whole mass was perhaps 8 to 10 centimeters in the direction of the bowel and was nodular and sclerotic. No further exploration was made. A loop of the terminal ileum close to the cæcum was lifted into the incision and sutured to the peritoneum for a permanent ileostomy. The wound was closed in layers to the loop.

The patient had an uneventful convalescence and was discharged from the hospital on March 31.

The umbilicus is a permanent record of intra-uterine existence. Most of its diseases hark back to this period and have their origin in its abrupt termination. Until after birth the main blood stream of the organism flows through the umbilicus. Until a short time before this, it encompasses outpocketings of the gastro-intestinal and genito-urinary tracts in the form of the omphalomesenteric duct and the urachus. It is not uncommon for these to remain patent or for portions of them to become pinched off and persist as cell rests or cysts. It is as if the viscera, retreating hurriedly into the peritoneal cavity, had jammed their tails in this hastily closed door. The umbilicus may contain, therefore, besides the normal squamous epithelium, epithelium of intestinal, bladder, or even gastric type. All of these may give rise to primary carcinomata.

It remains also as a route of communication between the venous and lymphatic systems of the peritoneal cavity and the body surface.

The importance of the veins is illustrated by the "caput medusæ" of portal obstruction. It is abundantly drained by lymphatics and although the direction of drainage is mostly from it, there is little doubt but that in pathological conditions these become obstructed and the flow reversed in the same manner as is that of the veins. Pathologically the lymphatics are of importance in the occurrence of metastatic carcinoma at this site and also in accounting for the discoloration of the umbilicus in intraperitoneal hæmorrhage.

In 1916 Cullen collected from the literature 97 cases of carcinoma of the umbilicus. Of the 25 primary growths 3 were squamous cell epitheliomata and 22 adenocarcinomata having their origin in remnants of the omphalomesenteric duct. Of the secondary group in 27 instances the original growth was in the stomach, in 5 in the gall bladder, in 5 in the intestine, in 10 in the ovary, and in 4 in the uterus. In 21 instances the site of the primary tumor was not determined.

Since the publication of Cullen's book 3 cases have been reported: 1 case by Wohl of cancer of the umbilicus secondary to cancer of the transverse colon, and 2 cases by Warner in one of which the original growth was in the stomach and in the other in the rectum. Counting the author's case the figures at present are as follows:

Primary squamous cell epitheliomata	3
Primary adenocarcinomata	22
Secondary to cancer of the stomach	28
Secondary to cancer of the gall bladder	5
Secondary to cancer of the intestines	8
Secondary to cancer of the ovary	10
Secondary to cancer of the uterus	4
Site of primary growth not determined	21
	101

In the cases secondary to cancer of the bowel the site of the primary lesion was as follows:

Rectum	3
Transverse colon	3
Cæcum	1
Nearly all of large intestine	1
	8

The manner in which the malignant cells reach the umbilicus is of considerable interest. Usually it is by way of the lymphatics, but in 5 cases secondary to carcinoma of the stomach and in 1 case secondary to carcinoma of the transverse colon, the primary growth had become adherent to the peritoneal surface of the navel and had ulcerated through with the formation of a gastro-umbilical or colo-umbilical fistula. In several instances the tumor originated from a secondary nodule in the omentum which had become adherent in the sac of an umbilical hernia.

The usual route of extension is, however, via the lymphatics. These are divided into three sets: the superficial running in the subcutaneous fat to the axillary and inguinal glands; the properitoneal running in the properitoneal tissue to the deep inguinal glands; and the peritoneal draining also into the deep inguinal glands and upward through the diaphragm into the parasternal chains. There is a separate channel running along the round ligament of the liver.

Were the normal lymphatic stream toward rather than away from the navel, umbilical carcinoma secondary to carcinoma of the viscera would doubtless be more common. As it is, it is probable that for cells to arrive there the normal stream must be obstructed and the flow reversed. This is doubtless the reason that it is most often secondary to cancer of the stomach and ovary, malignancies which metastasize early and extensively to the peritoneum, and in the case of the former to the liver. In carcinoma of the stomach and intestines metastasis is usually by way of the round ligament and is secondary to nodules in the liver. In cancer of the gall bladder extension by the same route is obvious. Some writers suggest that metastasis may even be retrograde from the inguinal glands. In pelvic conditions this is not beyond the possible.

PATHOLOGY

The umbilical growths may vary in size from small subepithelial or epithelial nodules to large ulcerated tumors. The smallest growth observed was but a few millimeters in diameter, while the largest was the size of a child's head. The size and degree of ulceration depend, of course, upon the duration.

When the involvement is by direct extension from the stomach or intestine, the

picture is usually distinctive. No definite nodule develops; rather there appears a deep induration at the umbilicus which gradually takes on the appearance of a phlegmon. As the viscus perforates into the abdominal wall, fluctuation occurs and incision at this time will often yield definite pus. The condition goes on to malignant ulceration, fistula formation, and discharge of gastric or intestinal contents.

Microscopically the primary growths are either typical squamous cell epitheliomata or adenocarcinomata of the intestinal type. A secondary tumor reproduces the characteristics of the original lesion. When this is in the intestine it is difficult to distinguish microscopically between primary and secondary growths.

SYMPTOMS

In primary growths the symptoms will be wholly local or those incident to metastases. In secondary tumors, in most instances, there will be symptoms of advanced malignancy of one or another of the abdominal viscera. This is not always the case. In 14 of the secondary cases the umbilical nodule was the first thing noted and at the time of observation there were no symptoms referable to the original lesion, this being discovered accidentally at operation or at postmortem examination. This point is of considerable clinical importance, making it requisite in all cases of carcinoma in this region to make a thorough search for a latent visceral focus. Occasionally there will be a history of a long standing umbilical hernia. In this case it is probable that the growth is an extension of an omental nodule adherent in the sac.

DIAGNOSIS

Carcinoma must be distinguished from many other tumors which may arise at the umbilicus. To recount them all and give their distinguishing characteristics is beyond the scope of this report. The more important of them are hernia, abscess, hypertrophy, adenomyoma, cysts (dermoid and those arising from remnants of the omphalomesenteric duct and the urachus), benign tumors of vascular, lymphatic, fat, or connective tissue origin, and sarcomata.

CONCLUSIONS

1. A case is reported of cancer of the umbilicus secondary to adenocarcinoma of the cæcum.

2. There is presented a clinical and pathological summary of the 101 instances of carcinoma of the umbilicus which to the present time have appeared in the literature.

I wish to express my thanks to Dr. C. A. Hedblom, upon whose service the case occurred, and who was kind enough to allow me to report it; also to Dr. E. M. Medlar who examined the tissue removed at biopsy and made the microscopic diagnosis.

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[1] Those who do work in this field should be infinitely grateful to Dr. T. S. Cullen for his excellent monograph.

CHONDRODYSPLASIA[1]

By WALLACE H. COLE, M.D., F.A.C.S., St. Paul, Minnesota

CARTILAGINOUS tumors are frequently found in the human body and of these, the skeletal types are by far the most common. The classification is, however, far from clear, because of the marked variation in both the clinical and pathological characteristics of these tumors and the allied dystrophies, and probably no definite lines of demarcation will ever be distinguished. These varied features, to quote Ewing, are "perhaps dependent upon the facts that cartilage is essentially an embryonal and transitory tissue, and that cartilage cells, although encased in a firm matrix, have rather active, proliferative powers, possess amœboid properties, and are readily subject to metaplastic changes." One type of case which has appeared rather infrequently in the literature is the so-called chondrodysplasia, or Ollier's disease, and the observation of what is apparently a unique case of this condition has led to the making of the following brief report.

Ollier, in 1898, reported a case of cartilaginous dystrophy in which the extremities of one side of the body were, as a result, markedly retarded in growth, and to which he gave the name of dyschondroplasia. In 1900, Molin, working under Ollier, published a thesis at Lyons, entitled "Dyschondroplasia, a Roentgenological and Clinical Study," to which an introduction was written by Ollier and in which three cases of the condition were reported, one of these being the original case of Ollier. All of these showed a typical asymmetry, although in one there was a crossed distribution, the right lower and the left upper extremities being involved. According to Ollier, the condition is characterized by irregularity and retardation of ossification at the epiphyseal cartilage, for this cartilage does not submit to the normal process of ossification but persists as cartilaginous masses and nodules which take a long time to transform themselves into bone. These nodules may be superficial or deep, that is, subperiosteal or medullary. The condition is observed most clearly in the phalanges of the fingers and toes, principally the former, all the affected bone being sometimes involved and sometimes only a part. It is as if little chondromata were disseminated in the tissue of the phalanx. In the long bones the tumors are in the juxta-epiphyseal regions and when on the surface, the more common occurrence, resemble exostoses. When in the bone, the juxta-epiphyseal areas are transformed into transparent masses which are regularly swollen and more or less voluminous, in this case the epiphysis remaining more cartilaginous than normal for the same age. The roentgenogram shows the deformed contour of the bones and the cartilaginous masses interrupted by denser white spots. Ollier's short definition of dyschondroplasia is: "An affection of the period of growth, with arrest of growing parts of the skeleton, with nodosities and swellings of the extremities of the corresponding long bones, curving of diaphyses, and slight but constant deformities of the hands." He believed that the so-called osteogenic exostoses and dyschondroplasia were identical. Nové-Josserand, who has also studied one case of this condition, mentions the "hemiplegic" distribution as an important characteristic and differential point.

Molin's study caused him to arrive at the following conclusions:

1. Dyschondroplasia is an osseous dystrophy characterized from a clinical point of view by partial arrest of development of the skeleton.

2. The disturbance of the bony growth affects by preference the long bones of the extremities and the metacarpophalangeal skeleton of the hand.

3. The long bones show curvatures analogous to those of rickets.

4. Joint deformities must be considered as the direct consequence of bony alterations.

5. Only the roentgenograph allows the nature of the dystrophy to be observed; it approaches that of rickets and chondroma but does not completely simulate them.

[1] Read in part before the Minnesota Pathological Society, February, 1924.

6. The definite isolation of this condition cannot be made on account of the absence of complete microscopical and macroscopical findings.

7. The identity of dyschondroplasia and osteogenic exostoses needs further pathologico-anatomical control.

8. The etiology is absolutely unknown.

The three cases reported by Molin are briefly as follows:

CASE 1. Girl, aged 10 years, with practically a negative history, developed a slight limp when 5 years of age and was found to have at that time a shortening of from 2 to 3 centimeters. Examination showed a "hemiatrophy" of the right side, the hand and foot being also both involved. The right upper extremity was 6 centimeters shorter than the left and the lower extremity 8 centimeters shorter than on the opposite side. The deformities were a compensatory scoliosis, and an equinus position of the foot on walking.

CASE 2. Girl, aged 12 years, gave a negative history. At 3 years of age a deformity of the right knee was noticed and about the same time a deforming lesion of the left hand was found. At the time of the examination a marked genu valgum was present and the right lower extremity showed 10.25 centimeters shortening. A later observation on this same case showed a subluxation of the hip on the affected side and a valgus deformity of the knee of nearly 90 degrees.

CASE 3. Boy, aged 6½ years, gave a negative history. The child learned to walk at 11 months of age and shortly after this a slight limp was noticed. On examination, the right arm was found to be about 5 centimeters short and the right leg 5.5 centimeters short.

Coon, in 1911, reported a case which, after a search of the literature, seemed to be at that time the only additional case of dyschondroplasia after Molin's on record.

Coon believed that the only true diagnostic method was the roentgenogram, the only similar picture being that of multiple cartilaginous exostoses.

The patient, a boy aged 15 years, gave a negative family history and his previous history showed apparently nothing which could be directly connected with his condition. When he was less than 3 years of age a swelling was noted in the region of the right wrist, following an injury a few weeks before, and from this time on other "bunches" appeared in both the upper and lower extremities on the right side, and the parents noticed that these extremities were not growing as fast as those on the left. When he was 13 years of age some small lumps had appeared on the left hand. The examination of the boy showed the right side to be much deformed, the upper extremity being 6.25 inches shorter than the left, and the lower extremity 3 inches shorter than the opposite side. The wrist and elbow were widened and masses could be felt on the humerus, but although the knee was thickened and there was a slight roughness of the metatarsals, no such masses could be made out in the affected lower extremity. A slight degree of genu recurvatum was also present, and the right foot was smaller than the left. The femur, tibia, fibula, and ulna on the right showed abnormal curves. The roentgenograms were very striking and showed much more bony involvement than was apparent clinically. Three different types of such involvement were observed. The first type, which was present also on the left side, was confined to the metatarsals, metacarpals, and phalanges and showed areas of lessened density with tumor formation, which probably represented true chondromata. The second type was present at each end of all the larger long bones of the affected extremities, and showed irregularity of outlines, increase in density, and a peculiar longitudinal striation with no tumor formation. The third type of involvement showed exostoses, these occurring on the olecranon, acromion, and coracoid processes, and on the shaft of the humerus.

Ehrenfried has apparently made the most exhaustive search of the literature on cartilaginous tumors and has written two articles on what he calls "Hereditary Deforming Chondrodysplasia—Multiple Cartilaginous Exostoses." The condition thus described covers a large group of cases, the characteristics of which are briefly as follows: It is an affection of the period of skeletal growth which is first noted usually in infancy or childhood, the manifestations increasing with skeletal growth, and ceasing with skeletal maturity. The lesions, consisting of cartilaginous and osteocartilaginous growths within and on the skeleton are multiple and more or less symmetrical and result from a disturbance in the proliferation and ossifications of the bone forming cartilage. Certain typical distortions and deformities of the skeleton occur and in the majority of the cases studied, the ulna and the fibula were disproportionately short in relation to the radius and tibia, with resulting deformities of the hands and feet. The fingers and toes showed bulbous juxta-epiphyseal enlargement with frequent irregularity as to length. The condition is apparently generally symmetrical with minor differences only, for out of the more than 600

cases found in the literature by Ehrenfried, only 5 or 6 showed a marked asymmetry (Molin's cases, etc.). Hereditary relationship in this series was present in about 60 per cent of the cases. Roentgen examinations showed typically juxta-epiphyseal hyperostoses, particularly around the larger joints, with squaring off of the bones entering into the knee joint. Enlargements at the metaphyseal ends of the bones were thin in density and mottled or striated in the younger patients but denser and with longitudinal striations in the older cases. Bubble-like vacuolation, suggesting cysts, present particularly in the ulna, radius, and fibula, were very characteristic. Ehrenfried found that all the bones of the body could be involved but the cranium very rarely so.

Carman and Fisher have reported a case of multiple congenital osteochondromata in a man 30 years of age, in which all the bones of the body, except the skull and face, were involved. The microscopical structure showed a persistence and overgrowth of poorly ossified or calcified cartilage with the cells irregular in size and form.

Ashhurst, under the heading of "Multiple Cartilaginous Exostoses, Hereditary Deforming Chondrodysplasia" reviews Ehrenfried's work and some of the other literature and reports 11 cases of the condition observed by himself. He states that the underlying pathological change in cases of this sort is a chondrodysplasia affecting the metaphyses of the long bone, with the exostoses, being merely incidental and not the essence of the disease. No hereditary character was apparent in his series.

Bentzen has recently published a report of a case which is typically of the type under discussion.

A girl, 15 years of age, gave a negative family history. When she was 5 years old the parents noticed that her right leg was shorter than the left, and from that time on the shortening had become more pronounced. When she was 11 years old the right femur was fractured by a simple fall from a bicycle, the lesion occurring at a point where a subsequent examination showed rather extensive changes in the bone. Two other fractures, occurring at different times in the upper extremities, were due to severe injuries and had apparently nothing pathological in their etiology. At the time of the examination the leg was 8 centimeters shorter than the other and as a result there was a long right total scoliosis. Roentgenograms showed very remarkable structural changes in the bones of the right lower extremity and pelvis, the rest of the skeleton being negative except for an anomaly of the second dorsal vertebra. Films taken when the child was 7 years of age were at hand for comparison but aside from the fact that a certain amount of healing seemed to have taken place there was little difference in the pictures. Both metaphyses of the tibia showed longitudinal, stripe shaped, clear areas, as if long chips had been taken out with a gouge, and a similar picture was present in the wing of the ilium, the stripes being arranged in a rather irregular fan-shape. The lower end of the femur was involved in the same way, but around the region of the lesser trochanter there were spot-shaped clear areas. In the foot the first phalanx of the second toe was definitely involved and two clear spots were seen in the first phalanx of the great toe.

Bentzen was able to find twelve cases of "Ollier's disease" in the literature, but his was the first one recorded where only one extremity, the right lower, was involved. (The twelve cases recorded are: Nové-Josserand, 1; Ollier and Molin, 3; Wittick, 1; Coon, 1; Koehler, 1; Burchardt, 2; Bojesen, 1; Johansson, 1; and Johannessen, 1.) His study showed that although these cases differed from each other in some ways the roentgenograms were very characteristic and allowed the condition to be distinguished from all other known diseases of bone. The differences are due mostly to the different stages obtained and where the changes are great the stripes and spots disappear and the bone becomes very much deformed. All of the authors agree that the clear areas, seen either as stripes or spots, are due to cartilage being present where bone is normally found and the consensus of opinion is that these cartilaginous masses are not true tumors. Bentzen found a hemiatrophy of the face in his case and this was also reported in three of the twelve cases mentioned, the atrophy being on the same side as the involved extremities. The fact that this symptom is one which is found in lesions of the upper sympathetic tract, together with the observations that the distribution of the peculiar striping in the involved bones is apparently the same as the distribution of the blood vessels in the bones, and that the lesion is so typically asymmetrical led Bentzen to undertake a series of experiments on rabbits in which either the sympathetic cord was de-

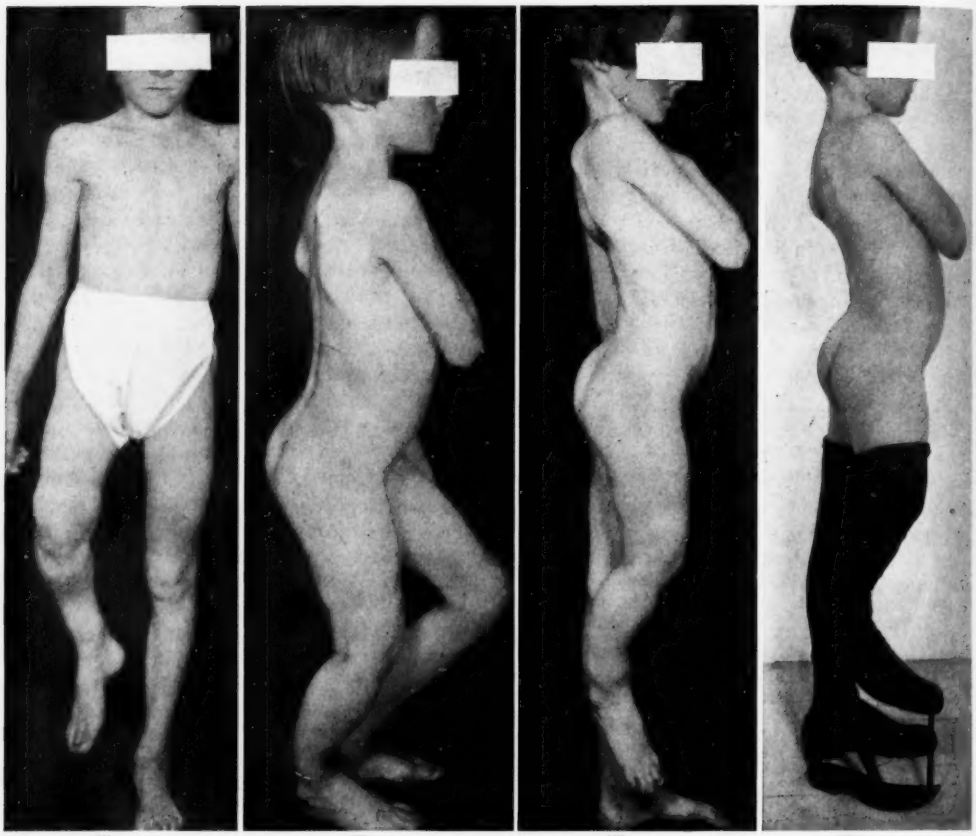

Fig. 1. Fig. 2. Fig. 3. Fig. 10.

Fig. 1. Front view of patient with weight borne on left or sound leg.

Fig. 2. Side view, both feet on the ground.

Fig. 3. Side view of patient with weight borne on left or sound leg.

Fig. 10. Lateral view of patient fitted with raised shoe.

stroyed or the region of the nutrient artery injected with alcohol and any bone changes followed with the roentgenogram and microscope. The results were positive in two animals and led Bentzen to the following conclusions:

1. Ollier's disease may be interpreted as the typical reaction of the bones against an active hyperæmia of the bone tissue, arising owing to anomalies in the vegetative nervous system, that is, disorders in the innervation of their blood vessels. (The anomaly in the second dorsal vertebra is discussed as to its possible relation to a sympathetic lesion at that level.)

2. The pathological processes in the bony tissue may be assumed to be related to the phenomena seen in the formation of callus.

White has observed two cases which he calls "Hereditary Deforming Chondrodysplasia," both of which had multiple cartilaginous exostoses. The condition was apparently of the symmetrical type in both cases.

Voorhoeve, of Amsterdam, has published an account of a condition which he believes is to be classed as dyschondroplasia, and which was present in a rather marked and symmetrical degree in a brother and sister and to a lesser extent in the father, the mother being

Fig. 5.

Fig. 5. Roentgenogram of thigh and leg, anteroposterior position.

Fig. 6.

Fig. 6. Roentgenogram of thigh and leg, lateral position.

Fig. 7.

Fig. 7. Roentgenogram of ankle and foot, lateral position.

free. These cases showed a longitudinal striation in the metaphyses of practically all the long bones in the body and the fan-shaped striation in the wings of the ilia as previously described in Bentzen's case. Voorhoeve's article goes into the literature very carefully and is one of the best discussions of the subject under consideration that has appeared.

Fig. 4. Roentgenogram of pelvis and thighs.

Fig. 8 (left). Roentgenogram of front of foot.
Fig. 9. Roentgenogram of left thigh and knee, anteroposterior position.

Very recently Fairbank has reported "A Case of Unilateral Affection of the Skeleton of Unknown Origin," in a boy, 12 years of age, which he does not believe can be classified under the heading of chondrodysplasia but which one reading the description and seeing the published roentgenograms is inclined to place in that class. The condition was confined to the right side of the body and the right leg was one-half inch longer than the left, a finding which is used as an argument against the diagnosis of chondrodysplasia as all reported cases of that condition show shortening of the affected extremities. The roentgen appearance is that of atrophy, striation and a sprinkling of dense spots with no alteration in the contour of the affected bones.

Jansen has just reported a case of "Unilateral Chondromatosis (Ollier's Disease)," in a 9-year-old girl. The left side of the body was involved but a few suspicious areas were also seen in the roentgenograms of the right side. The face was asymmetrical but no lesion of the sympathetic system could be demonstrated. Pathological tissue showed cartilaginous masses with bone marrow and blood vessels in the center. No fibrous tissue was found.

The author's case, which led to the search of the literature, the results of which are briefly summarized above, follows:

A girl, aged 11 years, came into the hospital, the complaint being that the right leg was markedly shorter than the left. This shortening had been present since birth and the doctor who saw the child at that time said it was probably due to mal-development. The family history was negative and no similar condition had ever been present in any of the members of the father's or mother's families, immediate or remote. The patient had the usual diseases of childhood with no complications.

Examination at the time of admission showed a marked shortening of the right lower extremity, with enlargements at the lower and upper ends of the tibia and the lower end of the femur and a palpable mass on the medial side of the shaft of the femur. These enlargements were hard and firm and felt like definite tumor masses. There was a marked varus deformity of the knee and a permanent flexion deformity of about 15 degrees was present in this joint (Figs. 1, 2, 3). Measurements showed approximately 20 centimeters shortening of the right lower extremity as compared with the left, the measurements being taken from the anterior-superior spines to the medial malleoli. There was a marked shortening of the second toe of the right foot but no other apparent lesion below the ankle. The ankle joint was apparently normal and the knee joint showed practically a normal range of motion.

A roentgen study of the skeleton disclosed a peculiar condition present, most prominently in the right ilium, femur, tibia, and second metatarsal bone of the foot. The upper extremities and spine were apparently negative. The right ilium showed in its wing a vacuolated area with increased density around it and rarefied areas above the acetabulum. The pubic bone showed slight similar changes. The right femur was much shorter and thicker than normal and two large tumor masses were present, one apparently originating from the shaft near its center and causing distortion, with a smoothly surfaced, although slightly irregular, vacuolated mass projecting medialward, and the other occupying the lower end of the bone and causing a symmetrical swelling with intact outline but showing in its body a very striking mottled appearance (Figs. 4, 5, 6).

The upper and lower ends of the right tibia showed swellings similar to that in the lower end of the femur (Figs. 5, 6, 7). The fibula was apparently not involved and as a consequence was very long in comparison to the shortened and thickened tibia. The first and second metatarsal bones of the right foot and the phalanges of the great and second toes, and to a lesser extent of the other toes, were involved and showed a series of vacuolated areas with dense striations in and around them (Fig. 8). The shortening of the second toe was seen to be due to the condition in the second metatarsal bone. The left femur showed a slight thickening and spindle-like enlargement in its middle (Fig. 9) and the upper end of the shaft and the neck showed definite rarefied areas with no tumor formation (Fig. 4).

A biopsy was performed and a portion of the tumor mass in the upper end of the tibia was removed. Grossly the mass was cartilaginous with a thin, bony shell. The microscopic sections showed mainly cartilage with small areas of bone distributed throughout. There was also well developed fatty bone marrow, with areas of red bone marrow. A diagnosis of chondrodysplasia with the formation of osteochondroma was made, the benign character of the lesion being assumed (Dr. E. T. Bell). No treatment seemed to be indicated so the child was fitted with an extension sole on the shoe which made up for the shortening (Fig. 10).

A study of the roentgenograms of this case, together with the findings in the literature, which have been outlined above, seemed to make the diagnosis of chondrodysplasia fairly certain. It seems impossible to separate absolutely the various types of cartilaginous tumors and dystrophies from each other and undoubtedly they are all related in a certain way, and it is therefore questionable whether the asymmetrical cases should be classified as

a separate entity, especially as some of these cases, such as Coon's and the one just reported show slight changes also on the opposite side of the skeleton. If the term "Ollier's disease" is to be used it should be used to describe the asymmetrical cases only, but with the understanding that the cases so named are only a small division of the large group of cartilaginous dystrophies called by various names but by Ehrenfried "hereditary deforming chondrodysplasia." Although heredity seems to be a factor in a certain percentage of these cases there are so many others, especially the asymmetrical type, which have no apparent hereditary basis, that it seems as if the omission of this term would be more suitable when naming the lesion. It is interesting to note the similarity between certain parts of the case being reported and the various cases reported in the literature. Ollier lays stress on the roentgenological picture of rarefied areas with denser white spots scattered throughout. This picture is seen very typically in the lower end of the femur and in both ends of the tibia in the author's case. Both Ollier and Coon speak of the areas of lessened density in the phalanges, Ollier describing them as similar to a small chondroma. This picture is similar to the one seen in the foot in the present case and the irregularity in the length of the toes which Ehrenfried brings out in his article is also present. The striations which seem to be such a striking feature of some reported cases and which have even been reproduced experimentally in rabbits, were not present in the case under consideration unless the appearance in the neck of the femur can be interpreted as such. Many roentgenograms of cases of proved osteitis fibrosa show a condition in the bone which simulates very closely that seen in some of the reported cases of chondrodysplasia but at no place in the films of the present case could such a condition be diagnosed and the differentiation should not be difficult.

CONCLUSIONS

The conclusions to be drawn from this brief review seem to be:

1. "Ollier's disease" is a term which seems fixed in the literature but which should be used only to designate those cases of cartilaginous dystrophy, with or without cartilaginous tumor or exostosis formation, which show an asymmetrical involvement of the body as the outstanding clinical feature.

2. Chondrodysplasia (a term preferable to dyschondroplasia) is a condition which is usually asymmetrical but as several symmetrical cases are on record the term must, therefore, be broader in its application than "Ollier's disease."

The gradation of reported cases between those of frank multiple cartilaginous exostoses on the one hand, and the so-called chondrodysplasia with no change in anything but the internal architecture of the bones (Voorhoeve's cases) on the other, is so varied and irregular, that a definite classification of cartilaginous dystrophies is still impossible. The possibility that the apparently widely different findings in some of these cases are only manifestations of different stages of the same condition must not be overlooked.

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A very complete list of the literature on chondrodysplasia will be found in the first two of the above. The author's list comprised practically the same references.

VARIX OF THE SUPERFICIAL EPIGASTRIC VEIN SIMULATING FEMORAL HERNIA

By WALTER HUGHSON, M.D., Baltimore
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CONFUSION in the differential diagnosis between varices in the femoral triangle and actual femoral herniæ is a matter of fairly common occurrence. Numerous reports of clinical cases appear in the literature, some of which have been diagnosed before operation and others not. A case is presented which is apparently unique in that the varix was of the superficial epigastric vein rather than of the saphenous. This fact may also account for the absence of some of the usual diagnostic signs of the condition.

The recognition of varices in the region of the femoral triangle according to de Quervain should present no particular difficulty. Though referring to dilatation of the internal saphenous alone, he says: "Fusiform or saccular dilatation of the vein disappears at the least pressure and reappears the moment the pressure ceases. Besides, the least variation of intravenous pressure, such as that caused by coughing and changes of position of the body, causes variation in the volume of the tumor; the bluish color of the blood sometimes shows through the skin. The signs are so clear it would seem impossible to make an error in diagnosis. It has, however, already been done!"

Coley lists the diagnostic signs as follows:

"1. Instead of suggesting a solid body on palpation it has a peculiar thrill as if fluid were being forced through a compressible tube.

"2. If the tumor is reduced and fingers pressed over the femoral opening and tumor slowly reforms it is a saphenous varix.

"3. In nearly every case there are well marked varicose veins."

These general points are emphasized also by Coopernail, Stetten, Noehren, Sistrunk, Erdman and others who have reported cases and discussed the diagnosis. Several instances of incorrect diagnosis of femoral hernia, of which the present case is one, are in the literature, the condition being recognized only at operation.

CASE 1. M. H. S., white, female, married, age 52 years, complained of a lump in the left groin.

Past history. Appendectomy in 1908 was followed by ventral hernia. Repair of ventral hernia was made in 1922 and again in 1923. The patient has had 4 pregnancies, a miscarriage occurring each time.

Present illness. Six years ago the patient first noticed a small lump in her left groin. This has slowly increased in size, but most rapidly during the past year. The swelling is barely noticeable while the patient is lying down, but becomes larger when she is standing or walking. She has not noticed any increase in size on coughing. For the past year the patient has felt a dull aching pain in the region of the swelling. This pain does not radiate and is more severe when the patient is standing up. There has never been any evidence of inflammation about the swelling.

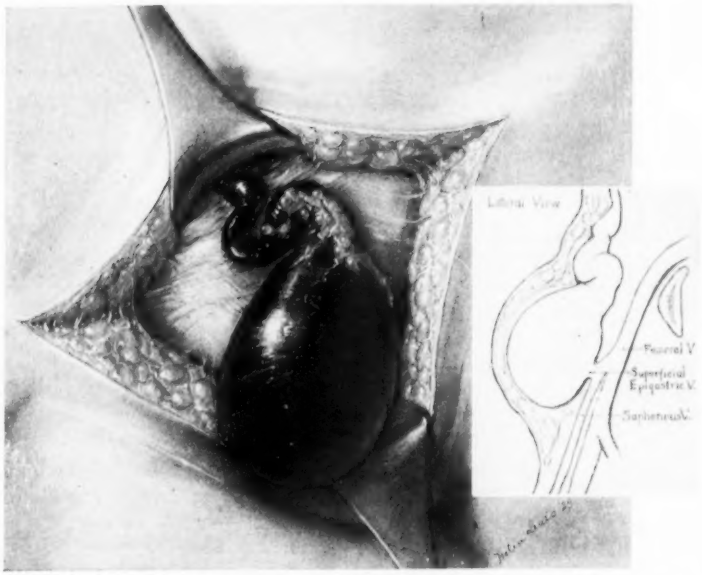
Physical examination. The patient is a rather obese white woman. Examination is essentially negative except for the scar of a right rectus incision (hernia repair), a few dilated veins over the lower part of the abdomen, and the local condition. In the left femoral region can be palpated a small soft mass about 4 centimeters in diameter, easily compressible. An impulse is felt on coughing. In the erect position the mass increases somewhat in size and extends further toward the median line. There is no discoloration of the tissues. Extremities are normal.

Diagnosis: Femoral hernia, reducible.

At operation, May 16, 1925, the usual incision was made and carried down through a thick layer of subcutaneous fat. As the tumor was approached it was seen to be of a purplish color. Particular care was taken in dissecting it and prompt recognition of its character made. At about 1 centimeter from its entrance into the saphenous vein, which was entirely normal, the superficial epigastric vein was found to be greatly dilated. This varix measured about 4 by 6 centimeters, the upper pole lying just below Poupart's ligament where the vein pursued its normal course though still about 3 times its normal size and markedly sclerotic. When emptied the varix was found to fill very slowly from above and rapidly from below; the walls were thin and there was no evidence of thrombosis. Proximal and distal ligatures were applied and the varix excised. There was no sign whatever of a femoral hernia.

Healing was prompt and the patient made an uneventful postoperative recovery. There was no indication of tumor on discharge.

The diagnosis in this case was undoubtedly obscured by the particular position of the varix (Fig. 1). Reduction of the tumor and



Appearance of varix after dissection from its bed, ⅔ actual size. It lies over the saphenous vein and femoral triangle. Insert shows lateral view of varix and its relation to other veins.

compression over the femoral ring gave the impression that the swelling was permanently reduced. There were no varicose veins of the leg. The thrill described by other observers was not felt. Possibly the dilated veins over the lower abdomen should have aroused suspicion, but, unfortunately, so far as an accurate diagnosis was concerned, they did not. The duration of the swelling, 6 years, was also unusual, most of the reported cases having been noticed only for a period of a few weeks or months.

CONCLUSION

A varix of the superficial epigastric vein is reported. Though such a condition of the saphenous is not unusual its occurrence in this particular vessel is apparently unique.

The usual diagnostic signs were absent in this case, possibly accounting for the erroneous clinical diagnosis of femoral hernia.

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SURGICAL MANAGEMENT OF THE ACUTE ABDOMEN[1]

By W. M. THOMPSON, M.D., F.A.C.S., Chicago

THE title "acute abdomen" was first used by W. H. Battle in 1911 as a substitute for the more prolix "acute conditions within the abdomen," or the less definitely descriptive "acute abdominal crises." Since then, because of its brevity and terseness, it has been given the stamp of approval by the surgeons who have written upon this condition.

As an introduction to my subject, the surgical management of the acute abdomen, I will review briefly the causes together with their results.

Of all the definitions of the acute non-traumatic abdomen, that of Deaver appears to be the most satisfactory. He says it is a sudden onset of acute, abdominal pain, preceded or followed by nausea or vomiting, or both, with tenderness and rigidity over the whole abdomen as a rule, but more pronounced over the most painful area; which is suggestive of the site of the lesion, with or without depression or shock.

The acute surgical abdomen is divided into non-traumatic and traumatic. The causes of acute non-traumatic abdomen are:

1. Infections
   - Appendicitis
   - Acute cholecystitis
   - Pyosalpingitis

2. Inflammatory lesions
   - Perforating ulcer
     - Duodenal
     - Gastric
     - Typhoid

3. Misplacements, torsions, and abnormal conditions resulting in intestinal obstruction
   - Bands
   - Postoperative adhesions
   - Ovary
   - Tumors
   - Spleen
   - Mesenteric thrombosis

4. Rupture
   - Intestine
   - Pancreas, hæmorrhagic pancreatitis
   - Ectopic pregnancy
   - Spleen
   - Uterus

5. Hernias incarcerated
   - Abdominal
   - Inguinal
   - Internal
   - Postoperative

The crisis of the acute abdomen may be the dissemination into the abdominal cavity of fluid, (1) either blood or cystic contents, or the contents of the stomach and upper intestinal tract at first relatively sterile, but not long remaining so, (2) pus from the appendix and fallopian tubes, (3) infected bile or pus from the gall bladder, (4) the contents of the lower intestinal tract which increases in degree of infection as we progress downward.

The acute abdomen in infancy and childhood needs special mention because abdominal pain in children does not at first excite any special alarm, hence children are often neglected. The diagnosis requires a combination of objective findings and a certain amount of intuition. Abscesses in children are less likely to be walled off. The omentum is smaller than in the adult and cannot act as easily as a dam against infection. Children do not usually stand operation as well as adults, but they generally show good powers of recovery. Abscesses in fat or robust children are usually of the fulminating type.

In infancy and childhood the chief causes of acute abdomen are:

1. Acute appendicitis
2. Intussusception
3. Pneumococcic peritonitis, a rare disease usually found in the female.

The traumatic abdomen may be divided into those which present evidence of internal injury and those which do not:

[1] Read before the Chicago Gynecological Society, December 18, 1925. (For discussion see p. 443.)

1. Perforating wounds
   Entrance
   Entrance and exit
   Abdomino-thoracic wounds
2. Non-perforating
3. Ruptured viscus either intestine or solid organ.

As we have only shock and the presence of free fluid as a means of diagnosing non-penetrating wounds, early exploration is the only treatment.

When a surgeon receives a patient with a diagnosis of acute abdomen from the family physician, the first question he asks is: "Is this an acute surgical abdomen or a referred pain from some thoracic lesion, as for instance, acute pneumonia or diaphragmatic pleurisy; or is it the gastric crises of locomotor ataxia, gastro-enteritis, or any other non-surgical disease?"

It is not the purpose of this paper to discuss the diagnosis of the acute abdomen, but to warn every surgeon to make his own diagnosis, and if there is time, to make a blood count. I should much prefer a complete count. In any case, it is better to depend upon clinical observation than to hold up the operation until the laboratory is heard from. Experience has taught that a diagnosis must be made independently of that made by the physician who refers the patient.

Morphine should not be used until an operation has been decided upon. When it is necessary to move the bowels enemas should take the place of cathartics.

It has been well said that "an operation had better be done early than well," but it should not be undertaken until the surgeon is satisfied by a careful analysis of the history and a painstaking examination that he is dealing with an acute abdomen. The surgeon must possess trained powers of observation, an open mind, and quick decision, and having made his decision he must proceed directly to each step in the treatment in order to succeed.

The points to be considered are time of operation, the choice of anæsthetic, lastly the method of operation (incision, treatment of the disease, closure of wound).

In dealing with the acute abdomen we are facing one of two conditions: first, pus or infected material has either burst into the peritoneal cavity or is threatening to do so, or, because of a perforating wound, the contents of the intestine is soiling the peritoneum. In the second instance, we have the rupture of a viscus or a tumor either through trauma or torsion or disease within the viscus as an acute hæmorrhagic pancreatitis. Here the time to operate is immediately, unless the patient is in a state of severe shock. In the first instance, if we are dealing with an unruptured abscess, the program is simple; but if rupture has taken place or if through a perforating wound the abdomen is becoming contaminated, the peritoneal cavity may be in what has been described as: (1) the stage of contamination, (2) reaction, (3) stage of peritonitis.

The operative procedure depends upon which of these three stages we have reached. It is to be understood in this discussion that the patient is not too badly shocked to undergo an operation if it is conducted rapidly and as a life-saving measure. The problem before the surgeon at this point is the extent of absorption. We will first discuss the absorptive power of the peritoneum with regard to the character of the fluid about to be absorbed. I am using this term to include all solid particles floating in the fluid, as débris, pus, corpuscles, and bacteria. We know that hypotonic fluids absorb readily, and that hypertonic fluids are reduced to isotonic by peritoneal exudate before absorption can take place.

Leathes and Starling (Hertzler) found that 39 per cent of a hypotonic solution was absorbed in the first half hour. At the end of 2 hours 49 per cent was absorbed. The slowing of absorption was due to the establishment of osmotic equilibrium. The absorption of blood begins in about 4 hours and is complete in about 48. Large solid particles are enclosed by exudate. Smaller ones are absorbed by the blood stream. It has been shown that the blood stream carries off the fluids faster and to a greater degree than the thoracic duct (McGuire). Experimentally, lymphaticostomy for the prevention of toxæmia from peritonitis has so far failed. Certain drugs injected into the peritoneal cavity have been

recovered in the thoracic duct, but much slower and in a smaller quantity than through a urethral fistula. Laboratory experiments are helpful in so far as they demonstrate the absorbing power of the peritoneum, but no worker has been able to reproduce the pathology and the septic fluid found in the acute abdomen.

It has recently been shown that fluids are absorbed with equal rapidity from all parts of the peritoneal cavity, which is contrary to the conception of former physiologists, who believed that the greater absorption took place in the region of the diaphragm. The movements of the diaphragm may increase the rate of absorption in that region, but the capacity to absorb is equal over all the peritoneum. In the early stages of rupture of an abscess, absorption is hastened. As soon as hyperæmia and inflammatory exudate appear together with damaged endothelium, absorption is delayed. Wagner found that increase in abdominal pressure hastened absorption as long as increased pressure is not great enough to retard the flow of blood. The factors which delay absorption are drugs such as opium, or albumin added to the abdominal fluids or in solution. A profuse, peritoneal exudate is no good omen for the patient. In the intraperitoneal conditions in which intra-abdominal pressure is increased, as for instance, tympanites in peritonitis, if the pressure is sufficient to check the circulation within the abdomen, caution should be used in reducing the intra-abdominal pressure, for tympany here is a conservative factor. If too free incisions through the abdominal wall relieve this pressure, undesirable absorption is increased. It goes without saying that unwise manipulation increases absorption. In the stage of contamination of the peritoneum there are three possibilities to be considered.

1. Material may be introduced in such quantities that death by intoxication may result before the defensive functions of the peritoneum can be mobilized. Thus we have the possibility of death by absorption of toxins before the reactive factors could be set into action; that is, before peritonitis could develop.

2. Small doses of bacteria might be destroyed before they could do harm.

3. Stagnating fluids in the peritoneal cavity would favor the development of bacteria. Thus the amount of infectious material, the kind of bacteria, and the state of preparedness of the peritoneum are the important factors. In the presence of these conditions there is no surgical procedure that demands more highly trained and co-ordinated assistants.

Local anæsthesia should be chosen for the first stage for the infiltration of the abdominal wall and blocking of the lower thoracic and abdominal nerves, procaine and adrenalin being used. In an encysted abscess it is possible to cofferdam the abdominal contents from the abscess, evacuate the abscess by suction, and infiltrate the mesentery of the cæcum in appendicitis, or do a subperitoneal infiltration in the region of the splanchnic nerves in duodenal or gastric ulcer. Successful intra-abdominal anæsthesia depends upon negative intra-abdominal pressure, and this is not always possible in the face of an invading infection, so that it is often best to resort to gas oxygen analgesia while adhesions are being removed. In the stage of peritoneal reaction before sufficient intraperitoneal pressure has developed to delay absorption, local anæsthesia may suffice.

If material in sufficient quantities has been introduced into the peritoneal cavity to cause death by intoxication, gas oxygen with a small percentage of ether may be the anæsthetic of choice. In those cases in which vomiting is a troublesome symptom, it is advisable to wash out the stomach and in patients in whom the contents of the small intestine are liable to continue to regurgitate, the stomach tube may be left in for further emptying and lavage. Acidoses and blood concentration can be prevented by hypotonic solutions, introduced subcutaneously or intravenously. The rectal injection of water or normal salt solution may stimulate peristalsis, a condition to be avoided; and it has been found that hypodermoclysis can be maintained for sufficient length of time to saturate the tissue. It is also to be borne in mind that this tissue saturation may slow up absorption

from the abdominal cavity. Since it has been found that acidosis following anæsthesia is one of phosphoric acid and not an organic acid, surgeons have abandoned sugar solutions, which only add to the hyperglycæmia, and are using hypotonic salt. For the treatment of hæmorrhage and shock blood transfusion takes precedence over all measures.

In the stage of peritonitis, if it is thought advisable to adopt the Murphy drainage method of operating, local anæsthesia is best. If on the other hand a radical incision is to be made there are two reasons for using general anæsthesia of gas, oxygen, and ether. First, the necessity for rapid anæsthesia, and second, the desirability of maintaining sufficient intra-abdominal pressure to prevent undue absorption. In such an operation, packs, intra-abdominally, sandbags along the side of the walls of the abdomen, and the assistance of the interne's hands may be used to maintain pressure.

Shock is an important factor in the treatment of abdominal cases. To anticipate shock is better than to be compelled to stop an operation and rally all the forces of the operating room to treat shock. We are all familiar with the signs of impending shock and I believe that every well equipped hospital should have its house staff trained to combat this condition in its incipiency.

In selecting the site for the incision we are influenced by two factors: the accessibility to the lesion, and the prevention of infection of the general peritoneal cavity. In acute lesions in which walling off is not to be expected, accessibility, generally speaking, is the dominant factor, while later when there is a partial or complete walling off the prevention of infection is the more important. Conservatism should be the aim of the surgeon. The acute abdomen is an emergency, and enough should be done to place the patient out of danger.

To complete a cure it may be necessary to do a two-stage operation, bearing in mind that the first is life-saving. It is a temptation, particularly to young surgeons, who are developing their technique, to prolong an operation unduly in their enthusiasm to perform a brilliant and spectacular operation.

The laws of physiology, not the laws of hydrostatics, are those which must be studied in attempting to solve the problem of drainage. As a general principle, gauze should not be left in contact with the coils of the intestines, but layers of porous, non-adhesive material, such as bobinette saturated with paraffin or perforated rubber tissue should be interposed between the intestine and the gauze. A rubber tube or an accordion rubber drain should be the choice for encysted abscesses. In acute peritonitis, where it is decided to use the Murphy incision, a rubber tube of sufficient caliber should be placed deep in the pelvis through a low central incision with cigarette drains through stab wounds in the flank and, over the dressings, a snug-fitting abdominal bandage should be applied. It is generally conceded that drainage is usually of no value after 48 hours.

Closure of the abdomen may be done in the single layer by means of the nævus needle, if the patient is in danger of collapse. If each layer is held by forceps and properly transfixed it is possible to get fairly good apposition, but layer closure is better.

SUMMARY

The majority of acute non-traumatic abdominal conditions develop from some chronic pathology. A careful review of the history is sometimes necessary to develop this fact. If the patient is too ill the relatives must be consulted in order to get a complete history. The extent of traumatic abdominal lesions can not be fully known except by operation. The experience in abdomino-thoracic surgery in world war wounds has shown that in operations performed within 10 hours of the time the wound was received, bold radical surgery was conservative. I believe the same rule holds in the treatment of the early stage of peritoneal contamination. Later when peritonitis has set in before it is decided whether to operate or not or whether a conservative or radical operation is to be done, one should judge the resistance of the patient, the extent of absorption, and the amount of infection in the peritoneal cavity.

Perhaps it is better in the light of our present knowledge to warn against inter-

ference in cases of peritonitis in which abdominal distention shows the approaching paralysis of the intestines, but I believe that laboratory experiment, clinical experience and observation will make possible an increasing number of patients that can be saved by a carefully thought out plan of surgical attack.

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THE NON-SPECIFIC ANTIGENIC EFFECT OF SPERMATOZOA UPON FERTILITY[1]

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THE purpose of these experiments was to determine, if possible, a serological explanation for sterility in the human which had no apparent anatomical or physiological basis. Dittler, Kovacs, McCartney, and others report temporary induction of sterility in rats by sensitization with rat spermatozoa. Waldstein and Ekler describe in rabbits a definite Abderhalden reaction to testicular protein following coitus.

Our object was to produce these antibodies experimentally in animals, to note their effect on a known existing fertility, and later to determine whether a similar sensitization to spermatozoa protein existed as a possible causative factor in human sterility. In addition we wished to determine:

1. Whether this effect were specific for species, that is, whether female animals sensitized by sperm of another species would give the same results as those sensitized by spermatozoa of the same species.

2. Whether ovulation was effected by this sensitization.

3. What mechanism caused this sterility, precipitins, agglutinins, lysins, or spermatotoxins.

4. What was the effect of sensitization upon females already pregnant.

TECHNIQUE

Female albino rats of the same family were used to eliminate familial variation. They were all about 100 days old and had already borne one litter, thus establishing their fecundity. A diet sufficient in vitamines was supplied as it has been proved that a deficiency of vitamines can readily induce relative sterility (6). The rats were kept warm, in clean cages, and supplied a varied diet of milk, green vegetables, and table scraps. Long and Evans' method of determining the presence of œstral cycle was used (20).

When a female was found pregnant for the first time, it was isolated until delivery of this initial litter and 10 days later at 4-day intervals was injected intramuscularly with 100,000, 200,000, and 300,000 spermatozoa. Two weeks after the last injection, active young males were put into the cages with the sensitized females and allowed to stay there continuously. Vaginal scrapings of these female rats were examined at regular intervals for the presence of œstral changes, care

[1]Read before the Chicago Gynecological Society, December 18, 1925. (For discussion, see p. 443.)

being taken not to repeat this often enough to traumatize the vagina and thus impair fertility. In a similar fashion human and guinea pig spermatozoa were used as an antigen. Controls were other female rats of the same age and selected under the same conditions but injected with typhoid bacteria and extracts of male salivary gland. It was found in earlier work that when blood for serological tests was obtained by cutting off part of the rat's tail or otherwise traumatizing the rats, fertility was impaired. The blood of the sensitized animals was obtained at the termination of the period of observation; animals whose blood was examined at other times were not listed in the results.

As an explanation for the mechanism of sterility search was made for the presence or absence of precipitins, agglutinins, lysins, or toxins in the sera of the injected animals by testing the effect of such sera on active spermatozoa, which were obtained by shaking them out of fresh testis into isotonic salt solution at 37 C. For precipitins the contact method was used, while agglutinins, lysins, and toxins were determined in hanging drops.

TABLE I.—SENSITIZATION OF RATS TO RAT SPERMATOZOA

(Results in 10 of a series of 40)

No.	Initial litter		Dates of injection	Results	Interval between mating of sensitized rat and subsequent litter
	Date	No.			
1	5–1–24	5	5–2–24 5–6–24 5–10–24	No preg.	24 weeks
2	5–3–24	5	5–2–24 5–6–24 5–10–24	No preg.	22 weeks
3	6–1–24	6	6–10–24 6–14–24 6–18–24	Litter of 5 9–15–24	12 weeks
4	6–3–24	5	6–10–24 6–14–24 6–18–24	Litter of 5 8–10–24	9 weeks
5	6–20–24	4	6–30–24 7–3–24 7–7–24	Litter of 4 9–1–24	8 weeks
6	6–25–24	7	6–30–24 7–3–24 7–7–24	Litter of 5 12–10–24	22 weeks
7	10–4–24	6	10–11–24 10–15–24 10–19–24	No preg.	22 weeks
8	10–9–24	5	10–11–24 10–15–24 10–19–24	Litter of 5 3–3–25	19 weeks
9	12–15–24	6	1–3–25 1–7–25 1–11–25	Litter of 6 6–1–25	24 weeks
10	1–29–25	6	2–2–25 2–6–25 2–10–25	Litter of 5 3–15–25	6 weeks
Average of 40 rats of this series					12 weeks

RESULTS

The intramuscular injection of rat spermatozoa into female albino rats with technique as outlined induced a period of sterility varying from 6 to 22 weeks with an average of 12 weeks (Table I). This confirms the work of McCartney (21) which stimulated interest as to whether the sterility produced in this manner is necessarily specific for species. In order to determine this, two series of animals were sensitized to human and guinea pig sperm. The results were significant in that rats injected with guinea pig sperm remained sterile from 6 to 29 weeks with an average of 14 weeks; those sensitized to human spermatozoa remained sterile from 3 to 26 weeks with an average of 14; four rats whose sera had been used during the observation period and hence not listed in the results, remaining sterile for over one year when they were killed; for rats over 18 months old are worthless for this type of research, approaching at this time their menopause (13). In contrast with these results, the controls after sensitization with typhoid bacteria and salivary gland extract had their second litters in 5.5 weeks which is about normal for healthy rats.

Ovulation persisted throughout the entire period of sterility in all animals as demonstrated by the cyclic changes in the vaginal scrapings.

SEROLOGICAL RESULTS

Precipitins for the spermatozoa used were specific up to dilutions of 1/128 in the sera of the sensitized animals; further readings were omitted because of the difficulty in reading the end point. This confirms Hektoen's results (9). The presence of specific precipitins was used as an indication of definite sensitization.

The question of agglutinins is of definite importance in sterility and despite the fact

TABLE II.—SENSITIZATION OF RATS TO GUINEA PIG SPERMATOZOA

(Results in 10 of a series of 20)

No.	Initial litter		Dates of injection	Results	Interval between mating of sensitized rat and subsequent litter
	Date	No.			
1	6-10-24	7	6-12-24 6-15-24 6-19-24	Litter of 6 9-11-24	11 weeks
2	6-17-24	6	6-12-24 6-15-24 6-19-24	Litter of 6 9-1-24	6 weeks
3	6-22-24	7	6-29-24 7-1-24 7-4-24	Litter of 4 9-15-24	12 weeks
4	6-28-24	5	6-29-24 7-1-24 7-4-24	No preg.	20 weeks
5	7-3-24	5	7-12-24 7-16-24 7-18-24	Litter of 5 10-1-24	10 weeks
6	7-11-24	6	7-12-24 7-16-24 7-18-24	Litter of 5 11-4-24	14 weeks
7	9-5-24	4	9-15-24 9-19-24 9-22-24	Litter of 4 11-11-24	7 weeks
8	9-14-24	7	9-15-24 9-19-24 9-22-24	Litter of 6 11-20-24	8 weeks
9	10-24-24	8	11-11-24 11-15-24 11-19-24	Litter of 7 12-26-24	6 weeks
10	11-7-24	7	11-11-24 11-15-24 11-19-24	No preg.	29 weeks
Average of 20 rats of this series					14 weeks

TABLE III.—SENSITIZATION OF RATS TO HUMAN SPERMATOZOA

(Results in 10 of a series of 20)

No.	Initial litter		Dates of injection	Results	Interval between mating of sensitized rat and subsequent litter
	Date	No.			
1	6-10-24	7	6-12-24 6-15-24 6-19-24	Litter of 6 9-11-24	11 weeks
2	6-11-24	6	6-12-24 6-15-24 6-19-24	Litter of 6 8-1-24	6 weeks
3	6-22-24	7	6-29-24 7-1-24 7-5-24	Litter of 4 9-15-24	12 weeks
4	6-28-24	5	6-29-24 7-1-24 7-5-24	No preg.	20 weeks
5	7-3-24	5	7-12-24 7-16-24 7-20-24	Litter of 5 10-1-24	10 weeks
6	7-11-24	6	7-12-24 7-16-24 7-20-24	Litter of 5 11-4-24	14 weeks
7	9-5-24	4	9-15-24 9-19-24 9-23-24	Litter of 4 11-11-24	7 weeks
8	9-14-24	7	9-15-24 9-19-24 9-23-24	Litter of 6 11-20-24	8 weeks
9	10-24-24	8	11-11-24 11-15-24 11-19-24	Litter of 7 12-26-24	6 weeks
10	11-7-24	7	11-11-24 11-15-24 11-19-24	No preg.	29 weeks
Average of 20 rats of this series					14 weeks

that Meeker (22) reports the presence of agglutinins in the human and McCartney in rats, in our experiments at no time would there be demonstrated more clumping in the specific sera than in non-specific controls; equally as marked clumping occurred with sera of men as with the specific sensitized sera. At no time were observed the classic agglutinations described by Lillie (19), Loeb (21), and Sampson (27) for marine forms in which the spermatozoa are clumped from a homogeneous suspension by the addition of saltwater egg extract. A marked difference was observed in results obtained with fresh sera and inactivated sera. Spermatozoa were immobilized in fresh sera in 20 minutes, while after inactivation the same sera allowed the sperm to remain motile for over 2 hours. As expected the more marked clumping occurred with inactivated sera in which the spermatozoa remained motile for a longer time. This fixation of the sperm could hardly be interpreted as due to *toxins* for it was as marked in the non-specific controls as in the specific sensitized sera. Bottner and Kirchheim (1) observed that in individuals who had had any foreign protein therapy and also in markedly cachectic individuals sperm remained motile for hours despite the fact that their sera had not been inactivated.

In these experiments at no time were *lysins* found in over 200 trials. No sera would cause the actual swelling and dissolution of spermatozoa in isotonic solution despite the fact that a definite precipitin for the specific sperm had already been demonstrated. Taylor (27)

Fig. 1. Photograph of agglutination of guinea pig spermatozoa by non-specific sera. X110.

reports the actual swelling and dissolution of sperm by blood sera of specific sensitized animals, but in no case could this be demonstrated in these experiments for frequently after 24 hours suspension in hanging drops in specific sera, spermatozoa would be found intact (Tables I, II, III).

EFFECT OF SENSITIZATION UPON GRAVID RATS

Pregnancy can be easily determined in rats by the absence of the normal cyclic changes in vaginal scrapings. In a series of 20 pregnant rats, injection of 100,000, 200,000, and 300,000 rat spermatozoa at 4-day intervals failed to have any effect upon pregnancy causing neither a decrease of the size, resorption, nor abortion of the litters. These negative results were obtained consistently and seem important in view of McCartney's opposite findings.

SEROLOGICAL RESULTS IN THE HUMAN

With these experimental facts as a foundation we next tried to demonstrate precipitins,

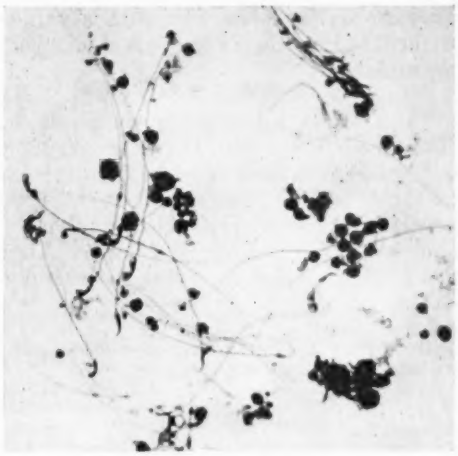

Fig. 2. Large "clump" in Figure 1 shown in greater detail. X230.

agglutinins, lysins, or toxins in the sera and cervical secretions of 17 normal, healthy, married women with patent oviducts and no evident pelvic pathology to account for the sterility. The husbands could be eliminated as an etiological factor for they could qualify in all of Huhner's precepts. In no case could any evidence of protein sensitization be found to human spermatozoa protein, suggesting that protein sensitization of the female in these so-called "idopathic" sterilities is more fanciful than real.

DISCUSSION

From these results confirming the work of others it is evident that there is an accurate method of temporarily inhibiting conception by sensitization of the female rat to any spermatozoa protein. This antigenic effect of spermatozoa is not specific for species; but equally good results can be obtained from the spermatozoa of any species. The mechanism causing this sterility is still not clear, only precipitins being definitely present and their significance an unknown factor. The rôle of agglutinins can be considered negative; for as marked "clumping" can be seen in the sera of non-sensitized animals, especially after inactivation, as in specific sera. Lysins were never seen and toxins which fixed or rendered

spermatozoa immobile were such a variable factor that from these experiments no opinion is justifiable.

CONCLUSION

These results cast no light upon the etiology of so-called "idiopathic" human sterility; they tend to eliminate protein sensitization as a causative factor. They do, however, suggest possibilities of supplying a contraceptive technique with a definite scientific basis and upon this further research is now being attempted.

I wish to express thanks to Dr. L. Hektoen for his constructive criticism and demonstration of technique, and to Dr. Mark T. Goldstine, from whose clinical material the human results were compiled.

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ACUTE HÆMORRHAGIC PANCREATITIS

Report of an Early Case, Recovery Following Resection

By EDMUND BUTLER, M.D., and G. D. DELPRAT, M.D., San Francisco

THE following case is, we believe, of interest because it was encountered quite free from any previous gastro-intestinal disturbances.

The family history was negative. For the past 12 years the patient has been a resident of Southern California, recently enrolled as a college student. During childhood he suffered a mild attack of measles and mumps, no sequela. At the age of 5 years he suffered from earache for about 4 months, subsiding without drainage. Although not subject to sore throat, he had the tonsils removed at the age of 9. He weighed 140 pounds, and during the past 6 weeks has gained 6 pounds. He gives a history of no other diseases or infections.

For 6 weeks immediately preceding his admission to the hospital, patient had been attending the Reserve Officers' Training Camp at Camp Lewis, Washington, and had enjoyed the best of health. During this time he led an active and strenuous life and was not fatigued. On the morning of June 26, 1924, he started from Camp Lewis to Los Angeles in a Ford, reaching San Francisco on the 27th at noon, having driven all day and all night. While on the journey he states that he "hardly stopped for meals." About 11 p.m. June 27, he was awakened by a sudden cramplike pain of great severity in the umbilical and left hypochondriac region. He immediately experienced a feeling of nausea and vomited the food eaten at the previous meal. The pain continued in severity but was now confined to an area as large as his hand, around and over the umbilicus. During the next 3 or 4 hours this pain continued, with occasional knifelike exacerbations, without radiating. At the end of this time the pain seemed gradually to extend to the left costal margin; after a short interval it spread down the left flank into the lumbar and hypogastric regions. It remained unabated until the patient entered the hospital. There was no radiation of the pain to the genitalia, to the back, or shoulder. There were no remissions.

Examination at the Emergency Hospital showed a young adult male, 21 years of age, suffering abdominal pain. There was slight flushing of the face. Patient quiet, perfectly oriented and answered questions readily, but was in continuous pain.

General examination was negative except for the abdomen. Respiration 24, pulse 90, of good quality. The abdomen when first examined showed spasticity of the left abdominal muscles which in a short time spread to the entire abdomen. Light pressure in the left upper and left lower quadrants of the abdomen was very painful, but in the right lower quadrant tenderness was most marked. A rectal examination showed marked fullness in the pelvis with excruciating pain from pressure on the pelvic peritoneum. The rectal temperature was 100 degrees F. The leucocyte count was 12,500 with 89 per cent polymorphonuclear and 11 per cent lymphocyte elements. The hæmoglobin was 80 per cent. Urinalysis showed the urine straw colored, acid, with specific gravity of 1038, a slight cloud of albumin, and an occasional granular cast in the sediment. The blood Wassermann report later came in negative.

Diagnosis: With these findings the diagnosis of an acute inflammation of the appendix was made, the appendix presumably pointing to the left along the base of the mesentery of the small bowel.

The patient was operated on under ether anæsthesia 11 hours after the onset of the symptoms through a right rectus incision. On opening the peritoneum we found a small amount of serosanguinous fluid. The appendix almost immediately floated into view, the vessels were slightly engorged. It was evident that the appendix did not account for the patient's symptoms. On drawing the terminal ileum from the pelvis a quantity of fluid was released, sero-sanguinous in appearance, containing many blood stained flakes of fibrin. Complete exploration of the small and large bowel failed to reveal pathology. A second incision was made through the upper right rectus and an examination of the stomach, duodenum, and gall bladder gave negative findings. Through an opening in the gastrocolic omentum the pancreas was examined. The head, neck, and body were normal in appearance and to palpation; in the region of the tail there was a mass the size of a mammoth walnut. The peritoneal surface in contact with this mass was œdematous and blood stained. One small area of a possible fat necrosis, the size of a small grain of wheat, was found in the greater omentum. This enlargement consisted of the tail of the pancreas, which was chocolate color with the glandular markings indistinct and blurred. Inasmuch as the pathological changes were localized definitely to the tail of the pancreas, resection seemed the logical procedure. Great care was taken not to wound the splenic vessels, which ran in a groove along the superior margin. The space left by the resection was drained by a cigarette drain coming out below the antrum of the stomach through the middle of the incision. Patient was returned to the ward in good condition. One-half of the specimen was sent to the laboratory of the Surgical Division of the Stanford Service of the San Francisco Hospital, the other half was sent to the Department of Pathology of Stanford University.

Following is the report of W. Ophuls, Department of Pathology, Stanford University Medical School:

"Specimen consists of a portion of the pancreas which on the cut surface shows irregular chocolate brown areas alternating with areas of normal tissue.

"Microscopically the sections show many lobules which are completely destroyed, others are partly necrotic surrounded by polymorphonuclear leucocytes. The interlobular spaces, as well as many of the lobules, contain many red blood cells as well as blood in various stages of decomposition. Some lobules are normal except for some hæmorrhage extending between the alveoli. Several of the larger veins contain recent thrombi. Pancreatitis, acute hæmorrhagic."

L. Eloesser of the Surgical Division of the Stanford Service of the San Francisco Hospital made the following report:

"Between all of the pancreatic acini almost uniformly distributed in thin and normal septa there lie recent hæmorrhages, but the cells of the acini themselves, as well as the islands of Langerhans, stain perfectly well and are not necrotic with the exception of a few minute areas at the very periphery, where there are also intra-acinary hæmorrhages and an inflammatory exudate in a few acini. These are definitely necrotic. The vessels are engorged. The pancreatic ducts are empty. Diagnosis: early hæmorrhagic pancreatitis."

The postoperative course of this case was uneventful. There was considerable drainage from the wound for several days, of purulent material, which contained no activated pancreatic ferments. Culture yielded a growth of hæmolytic staphylococcus aureus.

In this case it is interesting to note the absence of premonitory symptoms, and the absence of recognizable foci from which thrombi might have been carried to the pancreatic vessels. In 1912 Deaver and Pfeiffer discussed the etiology of acute pancreatitis and claimed that the disease was due to infection borne through the lymphatics. As the lymphatics run from the head of the gland to the tail, so infection more often commences at the head of the pancreas and extends into the tail. In the above case the tail of the pancreas showed marked pathology in which the remainder of the gland did not share. The close relationship existing between acute pancreatitis and biliary disease has been recognized by many investigators, and undoubtedly exists, but in the case now presented no pathology of the biliary system existed.

The absence in this case of shock and cyanosis so frequently associated with acute hæmorrhagic pancreatitis may be attributed to the small mass of the gland involved. The absence also of the typical fat necroses indicates that little if any of activated pancreatic juice was liberated into the peritoneal cavity. The symptoms more typically associated with acute hæmorrhagic pancreatitis would in all probability have supervened had the operation been delayed.

Possibly small hæmorrhages take place into the pancreas more often than we have any knowledge of, causing gastric upsets that are explained on the basis of indiscretions in diet. When these hæmorrhages take place in the head of the pancreas, and there is pathology present in the bile passages, a severe pancreatitis often results. If these hæmorrhages are slight and in the body or tail of the pancreas, it is our opinion that recovery without intervention often occurs. If the resistance is lowered by exposure, exhaustion, or some debilitating illness, plus focal infection, bacteria will undoubtedly lodge in the hæmorrhagic areas and produce just such a picture as we have described.

We firmly believe that slight hæmorrhages into the pancreas are not uncommon. Whether the infection comes through the lymphatics or blood stream, or is a retrograde infection coming through the pancreatic ducts, the resulting inflammation is similar except that the retrograde infection through the pancreatic duct is more extensive and activation of the ferments of the pancreatic secretion will cause more destruction.

REGISTRY OF BONE SARCOMA

PART I.—TWENTY-FIVE CRITERIA FOR ESTABLISHING THE DIAGNOSIS OF OSTEOGENIC SARCOMA

PART II.—THIRTEEN REGISTERED CASES OF "FIVE YEAR CURES" ANALYZED ACCORDING TO THESE CRITERIA

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INTRODUCTION

ONE of the primary objects of the registry was to keep an up-to-date list of living cases which had had bone sarcoma and which could be considered as cured. It should be remembered that the Registry was started for and by the family of a patient under the care of the writer for a supposed bone sarcoma. They wished and I wished to ascertain the actual facts as to whether there were any living cured cases of this disease and if there actually were, to ascertain the methods of treatment by which these patients had been cured. I was given a thousand dollars to pay my expenses in obtaining the required facts.

My first step (in August, 1920) was to address a circular letter to the individual members of the American College of Surgeons and to the surgical profession in general. The advice of Dr. Ewing and Dr. Bloodgood was sought in consultation. Through the kindness of my personal friends in several earnest clinics, follow-up investigations were started. In fact that gift of a thousand dollars made me and many others work and soon led the Regents of the College to add an aggregate of $8000 more, contributed from time to time, in order to answer these two simple questions. Now at the end of five years, only 17 cases of primary malignant bone tumors have been collected which in our opinion may be considered cured (Ewing's tumor, 4 cases—osteogenic sarcoma, 13 cases).

In spite of all our efforts my patient died within the year and autopsy showed that the supposed sarcoma was a metastatic cancer of unknown origin. The chagrin of the error in diagnosis was somewhat allayed when reports from various clinics stimulated by our investigation began to appear. Greenough, Simmons, and Harmer analyzing the cases from the Massachusetts General Hospital and Huntington Memorial Hospital, for instance, reported: "Perhaps the most surprising fact of the whole study is that of 148 cases, sent in as possible bone sarcoma, only 68 could be considered in fact to be cases of malignant newgrowth of bony origin; the remaining 82 cases proving on more detailed study to be metastatic tumors of bone (29 cases), sarcoma primary in the soft parts (28 cases), inflammatory conditions (11 cases), or tumors of a non-sarcomatous type (14 cases)."

It soon appeared that by-products were to be the result of our industry rather than the intended product of obtaining the answers to our simple questions. The Registry itself was a by-product, for when our collection of cases could no longer be of possible benefit to my patient the Regents saw that the same questions would be eternal. The friends of future patients would always want to know of the living cases and how they were cured. Five years have passed since the first circular letter went out and some of our by-products may be listed as follows:

1. Many contributions to the medical literature on bone tumors.
2. A more or less acceptable standard classification, presented and discussed in the form of a small book. (Reprinted in Bull. Am. Col. of Surg., 1926, x, No. 1, A.)
3. The impersonal proof of Dr. Bloodgood's contention that giant cell tumor is benign.
4. The impersonal proof that cases of giant cell tumor may be cured by radiotherapy.
5. The diffusion of Dr. Mallory's contention that benign giant cell tumor is not a neoplasm but a faulty repair phenomenon.
6. The impersonal proof that many of the cures from combined treatment by surgery, mixed toxins, and radium claimed by Dr. Coley are authentic.

7. The principle of co-operative education (concerning rare diseases) among laboratories (the founding of other Registries).

8. The possession by the American College of Surgeons of collections of data on 100 standard benign giant cell tumors, 100 standard osteogenic sarcomata of the femur, 100 standard osteogenic sarcomata of other bones, 50 standard cases of Ewing's tumor. (These data are neatly packed in trunk-like boxes available for study by investigators or by pathologists or surgeons who see few bone tumor cases but who occasionally must decide questions of life and limb.)

9. A principle suggested for the new Museum of the College (and for other museums) of accumulation of data on accepted standard clinical entities, in available form for intensive research and educational study.

10. The idea that the Museum might become a sort of patent office of new clinical entities. A practical example of this idea by submitting a collection of over 50 cases of Ewing's tumor.

11. The suggestion that the College should devote its energies to the standardization of series of surgical cases, asking from hospitals duplicate records of one series after another. (For instance, a check on the standardization of hospitals might be made in epitome on the manner in which the cases of bone sarcoma are registered since such registration tests not only the apparatus of roentgenologist, pathologist, and surgeon, but the education, cerebration, and practical efficiency of the staff and perhaps even their consciences.)

There are other by-products, but the true product of our industry is small—only 17 cases of 5 year cures of primary, malignant tumors of bone on which the Committee can agree even tentatively. And in these cases much essential evidence is lacking. In ten of these for instance the X-ray has been lost. The evidence on few of the 17 is entirely convincing.

As to the treatment, all but 1 of the 17 had amputation and that one had a local exploration followed by intensive radium treatment and mixed toxins. Nine of the other 16 also had toxins. Eight also had radiation. In 8 cases these treatments were combined. Seven had no other treatment than amputation so far as we know.

I think the average surgeon will perhaps be content with the two paragraphs above. He will continue to amputate in doubtful cases if he thinks there is any possible chance that no metastases have already occurred. He will ignore the fact that the one radium and toxin cure probably represents a greater percentage of cures among those where this combination of treatments has been attempted than the sixteen amputations represent to the vast number in which surgery has failed.

We have many unknown factors: (1) How many amputations have been done and failed? (2) How many cases have there been in which the mixed toxins have been *thoroughly tried* and failed with or without amputation? (3) How many cases have received *thorough* radiation with or without surgery.

We have few facts and can estimate as we please. The answers are probably: (1) Very, very many. (2) A good many. (3) Very few or even very, very few. And all this guesswork must take into consideration that of all the cases submitted to the Registry as sarcomata, the Committee believes only a little over 50 per cent were actually malignant primary tumors of bone!

Since the Registry was not quite 5 years old at the time this set of 17 cases was agreed on by the Committee (June 1, 1925), the real use of the collection in answering our question will not be attained for 5 years from that date. It can then deal with cases of standard diagnoses agreed on before the result is known. *At present we can only say that it is probable that an occasional case may be saved by amputation or by amputation combined with toxins and radium; and that in 1 atypical case of primary malignant bone tumor with metastasis in the groin the patient recovered after an exploratory operation and the postoperative use of Coley toxins and radium.*

Will the reader please reconsider the last sentence and bear in mind that these statements were made by the Registrar of a Committee of the largest surgical society in the world consisting of over 7,000 members, every one of whom has been repeatedly solic-

ited to register any case of bone sarcoma in which the patient is living, whether cured, under treatment, or moribund, and especially if cured 5 years ago!

And yet anyone in searching the literature will find many reports of cures and percentages of cures. Read again the above quotation from Greenough, Simmons, and Harmer, and reflect on the percentage of erroneous diagnoses compared with the percentage of cures.

However, the paragraph in italics does not give all our optimism for it is boiled down to the coldest hardest facts. We have other evidence that all of these therapeutic agents, amputation, Coley toxins, and radium are effective in greater or less degree. There are a few more cases remaining well 5 years which we *almost* accept. There are many 5 year cures in cases which we consider benign giant cell tumor and a considerable number of cases of osteogenic sarcoma are nearing the 5 year limit. We are confident that each year in the future the report of the Registrar will be more favorable—particularly in regard to the use of radiation.

The Committee of which I was Registrar will be abundantly satisfied if they have succeeded in establishing a moderately acceptable standard nomenclature and moderately acceptable criteria of malignancy. To recommend an absolute nomenclature or absolute criteria would be ridiculous. Nevertheless, nomenclature and criteria must precede statistics on therapeutics.

Part I.—Twenty-Five Criteria for Establishing the Diagnosis of Osteogenic Sarcoma

Our list of 17 cured cases applies only to primary malignant tumors of bone, that is, to our classes of osteogenic sarcoma (13) and of Ewing's tumor (4). Of the latter I shall say little because there is at this writing an article in press for the *Archives of Surgery*, by C. L. Conner which analyzes all our cases of Ewing's tumor and really gives the most up-to-date knowledge of this new entity. The four 5 year cures of Ewing's tumor No. 185, No. 267, No. 348, No. 398 will there be reported. They will also be reported from the Memorial Hospital Clinic of New York by Coley and some have already appeared in the literature in Ewing's articles. As will appear in Conner's critical analysis, Ewing's tumor is in a class by itself as far as prognosis under radiation is concerned. It was this favorable response to radiation which first led Ewing to see that it was a separate entity apart from true osteogenic sarcoma.

Before speaking individually of the 13 remaining cases of supposed 5 year cures, let us consider the criteria of malignancy in osteogenic sarcoma. Out and out cases of malignant osteogenic sarcoma will show every one of these points, although occasionally one or two may be doubtful, absent, or impossible to verify (Table I).

History

Nearly all histories of osteogenic sarcoma cases conform to the following five points:

1. *Onset.* The onset is with pain before tumor is noticed or pathological fracture occurs. The patient may not consult his physician until the tumor appears, but in that case careful questioning will bring out the history of previous pain, perhaps intermittent in character. History of preceding trauma is frequent but always open to the question of whether the trauma caused the lesion or only called attention to it. Pathological fracture is common as the first symptom in carcinomatous metastases or in benign central lesions as cysts and giant cell tumors, but so rare as to be merely the exception which makes the rule in osteogenic sarcoma. Late in the disease it is not very uncommon. *We may say therefore that unless pain precedes other symptoms we may suspect that the case is not one of osteogenic sarcoma.*

2. *Duration.* We rarely get a history of years. Not infrequently the symptoms have existed about a year before the patient seriously seeks medical advice, but it is very rare that a patient allows 2 years to elapse. On the other hand it is very unusual for a patient to seek advice before at least a month has elapsed. The pain is usually bearable at first. The earliest case which we know of had had pain for a little less than a month. In benign osteogenic tumors the history is usually of years.

TABLE I.

Criteria	Hubbard	Rixford	Wells	Blood good and Coley	Blood-good	Blood-good	Coley	Coley	Thompson	Coley	Blood good	Coley	Coley
Case Number	29	50	64	100	101	102	172	184	261	408	501	586	183
History													
1. Onset with pain—not fracture or tumor	0	0	+	+	0	0	+	0	+	+		0	+
2. Duration. Not years or weeks but months	0	0	+	+	+	+	+	+	+	+		0	+
3. General condition—health at first	+	+	+	+	+	+	+	+	+	+		0	+
4. Age. Not over 50 unless Paget's	+	+	+	+	+	+	+	+	+	+		+	+
5. Rapid growth—month by month	+	0	+	+	+	+	+	+	+	+		0	+
Examination													
1. Immobility of soft parts	+	0	+	+	+		+	+	+	+		+	+
2. Location—certain bones rare	+	+	+	+	+	+	+	+	+	+		0	+
3. No inflammatory signs	+	+	0	+	0	+	+	+	+	+		+	0
4. Joint not affected	+	+	+	+	0		+		+	+		+	+
5. Size and shape (not pedunculated)	+	+	+	+	+	+	+	+	+	+		+	+
X-ray													
1. Both, central and subperiosteal—not either alone				+			+					+	+
2. Old shaft present—not expanded				+			+					0	+
3. Invasive—no rounded contours to spongy bone				+			+					+	+
4. Osteolytic and osteoblastic—not either alone				+			+					+	+
5. Soft parts involved—at least extracortical				+			0					+	+
Microscopic													
1. Mitoses (hyperchromatism)	+	+	+	+	+	+	+	0	+	+	+	+	+
2. Pleomorphism	+	+	+	+	+	+	+	+	+	+	+	+	+
3. Tumor giant cells	+	+	+	+	0	+	+	+	+	+	+	+	+
4. Differentiation—partial	+	+	+	0	+	+	+	0	+	+	+	+	+
5. Tumor vessels	+	+		+	+	+	+	+	+	+	+	+	+
General													
1. Nature of pathological examination	+	0	0	+	+	0	+	+	+	0	0	+	0
2. Quality of data in general	0	0	+	+	0	0	+	0	+	+	0	+	+
3. Unanimity of specialists	+	+	+	+	0	+	+	0	+	0	0	0	+
4. The registry classification	+	+	+	+	+	+	+	+	+	+	+	+	+
5. The ultimate result	0	0	0	0	0	0	0	0	0	0	0	0	0

Therefore if the patient sought advice in less than a month or over a year from the onset of symptoms we may suspect that the case is not one of osteogenic sarcoma.

3. *The general condition.* Apparently bone sarcoma does not arise in the unhealthy except after 50 in cases of Paget's disease of the skeleton. If the patient was in poor health at the onset, the probabilities favor the tumor being inflammatory—tuberculosis, syphilis, osteitis, etc. Bone sarcoma seems to be a disease of the healthy, whose repair processes may be exuberant. This statement is not at variance with the belief of Ewing expressed to me in conversation, that persons who develop bone sarcoma may have some essential defect in their mechanism for tissue repair. I believe myself that these patients "repair to death" as persons with hæmophilia "bleed to death." That is that the mechanism which should check repair is absent or diminished, just as in persons with hæmophilia the clotting mechanism is abnormal. However, these sarcoma patients almost invariably *appear* to be in good health.

Therefore unless the patient is considered in good health just before onset we may suspect the case is not one of osteogenic sarcoma.

4. Age. With the exception of cases which also have Paget's disease, 12 in number, we have no instances of osteogenic sarcoma in a patient over 50. Paget's disease rarely occurs before 50. As recently computed by Bird and Sosman the incidence of osteogenic sarcoma in Paget's disease is 12 to 14 per cent (personal communication). In the recent Survey of bone sarcoma cases in Massachusetts the writer concluded that the incidence of bone sarcoma is about 1 to 100,000 in the population at one time.

Therefore in any patient over 50 who does not have coincident Paget's disease we may suspect the case is not one of osteogenic sarcoma.

5. Rapidity of growth. Benign osteogenic tumors (N.B. this does not mean benign giant cell tumor) may be exceedingly slow in growth, the change not even being noticeable from year to year; they may, however, have periods of increase of growth but this is seldom rapid enough to be noticeable month by month—rather year by year. Inflammatory conditions often noticeably enlarge day by day and very often week by week. Osteogenic sarcomata as a rule show steady enlargement practically always noticeable in a month.

Therefore we may suspect that a case is not one of osteogenic sarcoma if the enlargement has been noticeable day by day or week by week or has not been noticeable month by month. This statement of course excludes cases subjected to the modern therapeutic test of radiation.

EXAMINATION

Cases of osteogenic sarcoma nearly always conform to the following five points in examination.

1. Immobility of soft parts. Of course, this is a difficult point to determine but one in which experience readily teaches. Rarely does an osteogenic sarcoma permit one to feel the soft tissues roll over the bone as does a giant cell tumor or cyst. This point is reversed in the inflammatory conditions which when they have perforated the bone may cause as much or more fixation of the soft parts than osteogenic sarcoma. Under the microscope there is a marked increase of large vessels in the periphery about an osteogenic sarcoma. There are often huge dilated superficial veins. I believe this peculiar fixation of the soft parts may be due to the ramifications of these new vessels.

Therefore we may suspect that a case is not one of osteogenic sarcoma if there is clearly mobility of the soft parts over the tumor.

2. Location. Approximately one-half of all osteogenic sarcomata occur in the femur; one-quarter in the tibia; one-half of the remainder in the other long bones. Of the other bones in the skeleton the phalanges of fingers and toes, the carpal and most of the smaller tarsal bones appear to be exempt. Osteogenic sarcoma is rare in the shaft of a long bone, but this situation is the customary one for Ewing's tumor or for carcinomatous metastases and myeloma.

Therefore the situation of a tumor may make us suspect that it is not an osteogenic sarcoma if it is not in one of the known usual sites; and the suspicion is in inverse proportion to the frequency of occurrence at its site.

3. Inflammatory signs. In exceptional cases the usual signs of inflammation may occur in osteogenic sarcoma; they are not at all unusual in cases of Ewing's tumor. *Radiation may temporarily produce them.* However, the typical osteogenic sarcoma does not present, especially in its early stages, pronounced fever, tenderness, redness, leucocytosis, etc. Nevertheless these cases are usually mistaken for osteomyelitis.

Therefore unless the signs of inflammation are absent or very mild we may suspect that the case is not one of osteogenic sarcoma.

4. Condition of neighboring joints. The dissection of specimens of osteogenic sarcoma shows that it rarely invades the neighboring joints until late in the course of the disease or unless as a sequence to fracture or operation. Joint cartilage seems to act as a barrier to both benign giant cell tumor and osteogenic sarcoma. The latter almost invariably proceeds actually to the cartilage while the former often leaves a considerable amount of spongy bone between it and the cartilage. The presence of an osteogenic sarcoma near a joint does not involve the motion of the joint except in proportion to the fixation of the soft parts. Such limitation as there is is not due to spasm as is the case in inflammatory conditions of the

joint or peri-articular structures (unless there is fracture also).

Therefore in a case in which there is not a considerable degree of free motion in the adjacent joints we may suspect that the tumor is not an osteogenic sarcoma.

5. Size and shape. No early sarcoma of small size nor of distinctly pedunculated shape has yet been registered. The facts that they are usually well developed when first noticed, that they usually surround the bone or most of its circumference; that they are as a rule both intracortical and extracortical, that they grossly resemble callus, make the writer feel that it is almost absurd to suppose that they start in small areas and then spread. They can better be understood as starting in a region as callus does than in small groups of cells. If the latter why should they grow through the strong cortex to the other side no matter which side they start on? At any rate thus far all gross specimens show tumors of considerable size which are both medullary and subperiosteal with the old cortex more or less firmly in its old place. Pedunculated bone tumors are nearly always benign except when congenital exostoses have been excited by trauma to efforts at repair.

Therefore if a tumor is not of considerable size or if it is pedunculated we may suspect it is not an osteogenic sarcoma.

THE X-RAY

The X-ray also furnishes us with five pretty constant criteria.

1. Combined central and subperiosteal involvement. Good roentgenographic pictures of osteogenic sarcomata demonstrate this point almost as well as sagittal gross sections. One must bear in mind, however, that superimposed bone outside the cortex may make the medullary shadow irregular in density. The little cuff of reactive bone of trumpet shape which surrounds the upper limit of the tumor appears in the X-ray as a triangular space on each side of the shaft under the uplifted periosteal edge. The presence of this is a sure indication of subperiosteal extracortical involvement. It represents the last line of defense of normal osteoblasts retreating in circular formation as the tumor advances under the periosteum. Unfortunately, the same phenomenon sometimes occurs as a defense against inflammation so that this reactive triangle in itself is not diagnostic of sarcoma. Benign tumors are either inside or outside the old cortex. Malignant are both.

We may therefore suspect that it is not a case of osteogenic sarcoma when the X-ray does not show both medullary and subperiosteal involvement.

2. Presence of old shaft. As stated above we rarely dissect a specimen of osteogenic sarcoma without finding the old shaft in its normal position—even if it is in fragments. It may be almost entirely destroyed in old tumors, but even then the remaining fragments are seldom pushed much out of place. The contrary takes place in benign giant cell tumor which gives the appearance of distending the bone. In Ewing's tumor the cortex is usually widened by the thrust of the tumor cells between the lamellæ, and old bone may be carried somewhat to the periphery. In osteogenic sarcoma the perforation of the cortex seems to be as a rule transverse from within outward radially through the cortex, or perhaps in the opposite direction. We have no clue as to whether they start inside or outside the cortex. If new bone forms it follows these radiating lines. One must think of these radiating lines not as they show in the X-ray as spicules but as they really are in the gross specimen as ridges or osteophytes of irregular form on the surface of the cortex.

Therefore if the X-ray does not show the old cortex or fragments of it in normal position, we should suspect that the case is not one of osteogenic sarcoma.

3. Invasive character. Dissection shows and so do our standard series of osteogenic sarcomata that the advancing edge of these tumors in the spongy bone is practically never rounded and smooth as is nearly always the case in giant cell tumors and some vascular carcinomatous metastases. Osteogenic sarcoma advances by invasion of the cells and the margin is irregular. Giant cell tumors and a few vascular metastases advance by pressure atrophy due to their pulsation as do aneurysms.

Therefore a sharp outline of the tumor against spongy bone may make us suspect that we are not dealing with an osteogenic sarcoma.

4. Osteolytic or osteoblastic or both. A typical X-ray of a case of osteogenic sarcoma shows that the tumor is both osteolytic and osteoblastic. However, in rare cases, particularly if far advanced, these tumors may be only osteolytic or only osteoblastic. If wholly osteolytic the suspicion of metastatic carcinoma is aroused and if wholly osteoblastic of a benign osteogenic tumor. In most cases characteristic radiating spicules are shown and form a very positive sign, although exceptionally metastases or inflammation may produce them. The frequency of this sign of spicule formation is not enough to form a rule and the absence of it is not very strong evidence against osteogenic sarcoma.

Therefore unless the X-ray shows that the tumor is both osteolytic and osteoblastic or if it shows that it is wholly one or the other, suspicion that it is not a case of osteogenic sarcoma is aroused.

5. Involvement of soft parts. This is a difficult point on which to interpret the X-ray. Giant cell tumors which have burst their capsule have frequently been interpreted as having the soft parts involved, and yet dissection in such cases has never shown this form of tumor as actually invading the soft parts although it may push them aside on fascial planes. Vice versa, the X-ray of an osteogenic sarcoma may lead us to think it has not involved the soft parts and dissection will show that it has. If we define the "soft parts" as including the extracortical space between the raised periosteum and the bone as shown by the "reactive triangle" above alluded to at its upper limit, we may get much help. Dissection shows that when we find this condition the tumor is always at least subperiosteal and usually has also broken through the periosteum and begun to invade the soft parts.

Therefore we may say that a tumor which does not show in the X-ray either invasion of the soft parts or the reactive triangle is perhaps not an osteogenic sarcoma.

MICROSCOPIC CRITERIA

The microscope gives also 5 pretty definite criteria common to most osteogenic sarcomata.

1. Mitoses and hyperchromatism. The relative frequency of mitotic figures has long been a guide in estimating malignancy in all tumors. Rapid growth in most tissues is characterized by a relatively large number of mitoses. Like other criteria this one has its exceptions for numerous mitoses may occur for instance in fungating granulation tissue and also in certain benign tumors. In benign giant cell tumor for instance they are often quite numerous and if an operation has been done and the wound is fungating they are usually very numerous. On the other hand excess of mitotic figures is a very constant finding in typical osteogenic sarcoma. Hyperchromatism of nuclei is a parallel phenomenon probably equivalent to mitotic activity or at least indicative of it. Sometimes it is seen without it and yet it indicates it.

Therefore the finding of numerous mitoses in a bone tumor does not necessarily indicate osteogenic sarcoma, but absence or infrequency of mitotic figures should arouse the suspicion that the case is not one of osteogenic sarcoma.

2. Pleomorphism. All our instances of osteogenic sarcoma which have run a malignant course, showed this criterion constantly. The degree of pleomorphism is of course a matter of individual judgment. There is a normal range of variations of size and shape in normal cells which it requires experience to recognize. In some cells the range is great, for instance the endothelial leucocyte is protean in its ability to change in shape and size. In general a bone tumor must be considered within normal limits of pleomorphism if no cells are found which cannot be duplicated in normal inflammation. This is the rule in benign giant cell tumors for none of the 100 standard tumors of this kind in the Registry series contain even small numbers of distinctly atypical cells. On the other hand our series of osteogenic sarcomata all do. Ewing's tumors are not pleomorphic and yet are very malignant.

Probably the best single way in which to grade osteogenic sarcomata would be to base the prognosis on the degree of pleomorphism. This is equivalent to expert histologic opinion, for any good histologist probably bases his opinion of the prognosis in any malignant tumor largely on its pleomorphism, although he takes account of the other factors as mitotic activity, hyperchromatism

and the arrangement of chromatin, nucleus and nucleolus. However, it does not yet appear necessary to attempt to grade osteogenic sarcoma, for our collection is not yet large enough and as yet we cannot say bad, worse, worst. To say Bad is enough, for after 5 years search we find only 13 cures.

Therefore any bone tumor which does not show pleomorphism is probably not an osteogenic sarcoma.

3. *Tumor giant cells.* It is not difficult to demonstrate to a student the difference between typical tumor giant cells and foreign body giant cells. However, occasional doubtful giant cells are found, but very rarely are all the giant cells in a single slide doubtful. A few individual giant cells or small areas of foreign body giant cells are of frequent occurrence in osteogenic sarcomata, and have little significance in diagnosis, as they probably merely indicate hæmorrhage in the tumor. On the other hand one may confidently expect a tumor to be malignant if it contains tumor giant cells but not necessarily to be a primary bone tumor. Tumor giant cells may occur in cancer also but we seldom see them in bone metastases. Then, too, many osteogenic sarcomata show no tumor giant cells.

This criterion therefore is not universal, but we may say that its presence in an osteogenic tumor is a very reliable sign of malignancy; but its absence need not make one suspicious either of the malignancy of the tumor or of its place in the osteogenic series.

4. *Differentiation.* It has proved impossible to make the differentiation toward intercellular substances as fibro-chondro-osteo-criteria of malignancy. There is an endless variety of proportions of these intercellular substances and an imperceptible series of gradations from one intercellular substance to another. At most, differentiation can only be used as a criterion of degree, the less the differentiation, in other words the more cellular the tumor, the more malignant. And now that radiation has been shown to be effective in the inverse way it is still harder to use this factor as a criterion. For instance Ewing's tumor which may be simply an undifferentiated form of osteogenic sarcoma has nowadays with radiation a better prognosis than a relatively well differentiated osteogenic sarcoma of the chondro-type. Yet the relative proportion of cellular tissue in chondromatous tumors is very important in their prognosis, for the greater it is the worse the prognosis.

Therefore in an osteogenic tumor very complete differentiation or almost no differentiation is better than incomplete differentiation, and the evidence of quite complete differentiation should make us suspect that the case is not an osteogenic sarcoma, but a benign osteogenic tumor.

5. *Tumor vessels (vascular arrangement).* As this criterion is my own hobby I hesitate to present it but as I have found it very reliable even if new, I offer it for it may help others. Early in the Registry work I noticed that the malignant tumors had a different vascular arrangement from the benign giant cell tumors. The latter have only capillaries or sinuses without any walls except the endothelium lining them. As a contrast to this all malignant tumors have definite branching vessels with walls of varying thickness largely composed of tumor cells. In other words these tumors have a perithelial arrangement as a constant factor, and the vessels branch like the limbs or twigs on a tree. The tumor cells hang on them like swarms of bees, whether the cells have no intercellular substance as in Ewing's tumors or well developed cartilaginous material as in some "chondrosarcomata." One may see an endothelial lining or perhaps a lining of tumor cells, and immediately adjacent perithelial arrangements of cartilage cells. Great variety of appearance of these tumor vessels is a characteristic also.

I find these tumor vessels a constant factor. They are certainly useful in distinguishing giant cell tumors from the osteogenic tumors, benign and malignant. As a criterion to differentiate malignant from benign osteogenic tumors or callus it again becomes a question of the individual cells forming the walls. Benign osteogenic tumors do not have pleomorphic cells in the vessel walls. I made one error in considering exuberant callus malignant, on account of somewhat atypical vessels.

My personal conviction is that every osteogenic sarcoma shows tumor vessels and that a tumor which does not show them in several sections is not an osteogenic sarcoma.

Experienced pathologists have, of course, noticed these vessels as the vascular arrangement of tumors in general, but so far as I know they have not contrasted this vascular arrangement with the interstitial blood supply of giant cell tumors. Perhaps "vascular arrangement" is a better heading than "tumor vessels" which I have used hitherto.

GENERAL CRITERIA

There are five general criteria of malignancy in a bone tumor which seem to me important.

1. *The nature of the pathological examination.* For instance the most expert pathologist will not be able to give us as much help on the stingy bit of dried tissue handed him by some uninterested operator, as can a keen surgeon in an out-of-the-way clinic who has made a complete and careful examination and description of the amputated limb. Opinion based on careful examination of the dissected gross specimen by a competent pathologist or by a good surgical observer is very strong evidence for osteogenic sarcoma. Yet it is by no means absolute.

We have two gross specimens in the Registry Collection which have not yet been satisfactorily classified. For example, Case 187 which is claimed as a cured case of osteogenic sarcoma by Ewing and Coley, I have not included in the present list although Dr. Ewing examined the gross specimen and still possesses it. From the situation of the tumor in the lower end of the radius and from Dr. Ewing's own description, I suspect it to be a variant of giant cell tumor.

Nevertheless we may say that if the diagnosis is confirmed by competent examination of the gross specimen it is one of the strongest but not an absolute criterion. If other important criteria do not agree, the suspicion is aroused that the tumor is not an osteogenic sarcoma. Furthermore histological reports even by excellent pathologists on small and imperfect exploratory specimens should not be accepted unless in agreement with other important criteria.

2. *The quality of the data.* What has been said in regard to the character of the pathological data applies to the other data. A history taken by someone interested in the patient or in the bone sarcoma problem is likely to be much more fruitful than if carelessly taken by someone interested in neither. Our best histories have come from either the small hospitals where the patient is of paramount interest or from the occasional man in some large clinic who is interested in bone tumors.

The character of the roentgen data is of great importance. There is a deplorable tendency to neglect technique in bone cases. The greatest possible detail is needed and if attained, may be of more importance to the patient than the surgeon's knife. Undoubtedly we must look to the roentgenologist to find the criteria of diagnosis at the early stage when pain has begun and tumor has not yet appeared.

We may say then that the quality of the data has much to do with our conviction of the diagnosis of osteogenic sarcoma.

3. *Unanimity of the different specialists.* In typical instances of osteogenic sarcoma the clinician, the roentgenologist, the operator, and the pathologist all arrive independently at the same diagnosis. As our experience progresses and knowledge diffuses, this rule becomes more striking.

A patient entering a hospital which has cooperated in the work of the Registry will probably have his bone tumor independently diagnosed by the different departments. If one has doubt, all should have and probably actually have. General agreement however will be the rule.

To express this differently, any hospital which is doing its best for cases of bone tumor will promptly diagnose the majority of cases of osteogenic sarcoma independently in each department concerned and the synthesis of these opinions and the action to be taken on them will be the responsibility of someone familiar with the work of the Registry.

4. *The Registry classification.* A criterion of more or less value in regard to the diagnosis of a case of osteogenic sarcoma is whether or not it has been so accepted by the Registry Committee. This is neither final nor fundamental and merely represents the best obtainable collection of opinions on such data as is furnished at a given date. Any hunter knows the difficulty of distinguishing game

running through the woods. An idea of the height of the animal is obtained at one glance, the flash of a white tail at another, and the outline of horns at a third. The conviction that a deer has passed may be arrived at, but the story the hunter tells will be believed in proportion to his own experience and standing in intellectual honesty. At that, he may be mistaken.

Expert opinion would not be expert opinion if as a rule it were capable of proof. The relative importance of the criterion of the Registry Classification is of this degree and varies with the character of the data and of the Committee.

The entity of osteogenic sarcoma has been recognized by a group, as hunters recognize a rare animal by repeated glimpses in all degrees of perfection, from a flash through the woods to the slaughtered, dissected, stuffed, macerated, dried, bottled, or serially sectioned individual. One hunter who might recognize the fossil vertebræ of the animal might not recognize the living creature darting through the woods. The practical hunter would, although he might confuse it with one of an allied species. The Registry Committee has had the advantage of being aided by much expert help and by varied points of view from different individuals. It has succeeded in establishing this entity and describing its characteristics but in individual cases it may be mistaken on fleeting glimpses. The 13 cases here submitted are of this character. It is our belief that they were instances of osteogenic sarcoma, but we ourselves recognize the possibility of error.

In our series of 200 standard osteogenic sarcomata nearly 50 per cent are still living under the 5 year limit. We feel much more sure of the correctness of diagnosis in most of these cases than in the 13, although in many much of the outline was behind the trees.

5. *The ultimate result.* It is easy to say that the Committee modify their diagnoses when they know the result. This is true; we do, so far as we can, but in many cases we do not yet know the result. We have also been criticized for letting each expert see the opinions of those given before him. We are in fact glad to have him do so. We want every bit of information and advice we can get, and so should every expert. It can do no harm, for we realize that on such data as we get, this writing of opinions is often merely an amusing mental exercise.

To be sure there is a serious side when we think of how many unregistered cases of bone sarcoma do not even get the benefit of the opinion of the Registrar which is freely given for rich or poor and always should be. In our hospitals, decisions in cases of bone sarcoma are often made on less experience than that which even a newly appointed Registrar would have at his command. Very few pathologists or surgeons see 10 cases of this lesion in their whole professional careers, where the diagnosis is definite and the outcome known. A new Registrar who has studied this series of 650 cases could certainly be of help to anyone on whom the responsibility of decision of life and limb rests.

But we must confess that even the most experienced after the study of all the 650 registered cases must sometimes modify his diagnosis by the ultimate result. If a case diagnosed as osteogenic sarcoma does not die within 5 years with metastases in the lungs all criteria should again be scrutinized with the greatest care.

Part II.—The 13 Cases of 5-year Cures of Osteogenic Sarcoma

As most of these cases have already appeared in the literature I will merely give references and discuss a few points in each.

Case 29. This case has never been published in detail. It was that of a boy of 14 with a tumor of the upper end of the tibia. He was the nephew of an able surgeon who recognized the seriousness of the lesion within 6 weeks of onset and promptly did a thigh amputation. It is perhaps the record for prompt diagnosis and treatment. The patient has been well for 9 years. An interesting feature of this case was that postoperative treatment was conducted by Dr. James B. Murphy of the Rockefeller Institute on his theory derived from experiments in animals that a mild lymphocytosis repeatedly aroused by light, diffuse doses of the roentgen ray prevents experimental inoculation of tumors in animals and, therefore, might prevent the growth of small metastases in the human being.

There are several of our criteria lacking in this case, for instance the onset was with trauma not pain; the history a matter of weeks rather than months; no X-rays or gross specimen have been preserved; the hyperchromatism is not great nor are single mitoses very frequent. In fact the diagnosis is largely based on the extreme pleomorphism of the

TABLE II.--FIVE YEAR CURES—THIRTEEN CASES

Case	Reg'st'd by	Name	Age	Bone	Previous partial ops.	Date amp.	Date last report	Tox-ins	Radia-tion	Reported in
29	Hubbard	S.	14	Tibia	O	6-23-16	June, 1925	O	O	Never reported.
50	Rixford	O.	44	Femur	O	1-22-09	Oct., 1924	O	O	Binnie's Surgery, vol. iii, p. 456.
64	Wells	B.	19	Femur	+	8-5-09	June, 1925	O	O	Surg., Gynec. & Obst., 1922, May, p. 698.
100	Bloodgood & Coley	P.	23	Femur	+	Aug., '17	April, 1925	+	+	To be reported by Coley.
101	Bloodgood	N.T.	24	Femur	O	7-8-13	May 16, '24	O	O	J. Radiol., 1920, Mar., p. 149.
102	Bloodgood	B.	11	Tibia	+	May, '13	April, 1925	?	?	J. Radiol., 1920, Mar., p. 148.
172	Coley	S.	19	Femur	?	Aug., '20	April, 1925	+	+	To be reported by Coley.
184	Coley	T.	26	Femur	O	8-20-16	Jan., 1924	+	+	To be reported by Coley.
261	Thompson	M.	11	Femur	O	4-8-16	Oct., 1924	O	O	Surg. Clin. of North America, 1922, Oct.
408	Coley	D.	18	Femur	+	4-7-06	April, 1925	+	O	To be reported by Coley.
501	Bloodgood	S.	?	Femur	+	1-18-13	June, 1924	?	?	Not reported.
586	Coley	F.	48	Femur	+	10-31-16	April, 1925	+	+	To be reported by Coley.
183	Coley	St.		Tibia		Not amputated		+	+	To be reported by Coley.

cells, the presence of many typical tumor giant cells with multiple mitoses and Dr. Mallory's original written report on the gross specimen. There is general agreement among the pathologists.

CASE 50. See Binnie's *Surgery*, vol. iii, p. 456.

This was a man of 44 with a very large tumor of the lower end of the femur. The case lacks some very important criteria. The age, 44, was exceptional. There was little pain, and tumor was the first symptom. The tumor had been present 3 years at least. It had differentiated largely to cartilage and bone, and there was little cellular tissue. There are no X-rays and no detailed description of the gross specimen. The diagnosis rests wholly on a few small areas which show a cellular growth with some mitotic activity and pleomorphism. Yet there is agreement among the pathologists on grading this as an osteogenic sarcoma rather than a benign or borderline chondroma. There are typical tumor giant cells.

The history, however, is strongly against this being a real case of osteogenic sarcoma. "Patient has always been well except as to his left knee on which 3 years ago he first noticed a small lump on the outer side; this, patient says, was movable. Patient indicated that this was at the summit of the external condyle of the left femur. He knows of no injury save a slight blow at this point received some weeks before the lump was noticed. The lump has grown pretty continuously ever since, although being stationary at times. It has never receded; has never been painful but was tender at one spot on the upper side of the patella. There is some tenderness in walking. Patient says that he has rather gained weight recently than lost."

Patients with osteogenic sarcoma of the femur do not usually walk 3 years without pain and gain weight. This is the exception which proves the rule unless the histological malignancy in this case is the exception which proves another rule.

CASE 64. This case was reported by Wells. Neither gross specimen nor X-ray was preserved. There were marked inflammatory signs. Repeated operations were done which might well have diffused metastases.

The diagnosis is based on expert opinion on the slides and is not strongly positive for most of the tissue is obviously inflammatory. While agreeing in the diagnosis, there is evident doubt among all the pathologists.

CASE 100. After two incomplete operations the thigh was amputated. She was also treated by Coley toxins and radiation.

This case fulfills all the criteria with the possible exception of differentiation. The tumor is so well differentiated that the sections closely resemble callus. Otherwise than this and the survival after so much surgery, the case seems a typical osteogenic sarcoma.

CASE 101. The questionable features in this case were of its inflammatory nature; onset by fixation of joint rather than pain; the presence of many of the signs of inflammation clinically and in the sections; involvement of joint. No X-ray is preserved and the character of the data is unsatisfactory. There is no agreement on classification among the pathologists except on the histological malignancy. There

is a question whether the tumor does not belong in the myeloma series.

CASE 102. No X-ray is preserved. The data in general are unsatisfactory. There is no good gross description of specimen but the histology is pretty typical of osteogenic sarcoma.

CASE 172. The one favorable feature is Ewing's description of the amputated leg: "Shows early and unusually limited central and subperiosteal osteogenic sarcoma."

CASE 184. The sections resemble a very cellular osteitis fibrosa and some of the pathologists class it as such. The Committee, however, feels that it should be classed as a sarcoma. Mitosis and hyperchromatism are not marked and differentiation is pretty complete. We have no X-ray and in such a case the X-ray would mean much.

CASE 261. This case has every unfavorable character except that the tumor was pretty well confined beneath the periosteum and in the center of the bone. Histologically it was very malignant. Amputation was done without exploratory incision and there was no after treatment. It is in my opinion the most typical and also the most complete case in the series. It shows surgery at its best.

CASE 408. The character of the exploratory operation through the joint rendered the prognosis very unfavorable. We have no good report of the gross specimen or X-ray. However, there can be little doubt from the description of the operation and the histology that this was a malignant tumor. It hardly seems as if amputation alone could have cured in this case. No radiation was used according to our notes; the mixed toxins were used, Compare the preceding case in which no exploration was done or after treatment given.

Although the pathologists agree that this case was malignant the histology is unsatisfactory for classification.

CASE 501. The notes on this case are very inadequate. There is no real history, no X-ray, and the histology is barely adequate to include it in this group. Several pathologists have raised the question of its being a giant cell tumor. Complete data, even one good X-ray, would probably expel all doubt.

CASE 586. This case is well registered with X-rays, photos, and slides but it is really not one of the true osteogenic sarcomata. "Had fractured femur at 4 and 11. At 21 had slight periostitis at site of fracture." In August, 1916, when 48 years old, he had a tumor of the femur at the site of one of the fractures. He was treated by curettage, X-ray, radium, and toxins for several months, and the thigh amputated October, 1916. Well in April, 1925. There was a fairly circumscribed mass at the site of the fracture and an open granulating wound over it. Histologically it is a sarcoma. There is doubt among the pathologists as to whether it should be classed as an osteogenic sarcoma at all or as a fibrosarcoma arising in scar tissue.

CASE 183. This case is the only one in which amputation did not contribute to the success which must have been due to radiation or toxins or both. It has been and will be again reported by Dr. Coley in full. It is a unique, remarkably encouraging case, for the limb was saved and metastases in the glands of the groin receded and did not reappear. Logically the mixed toxins and radiation must share the credit. There is an almost equally brilliant case, 267, among the Ewing tumors, also treated by radiation and toxins.

SUMMARY

One must realize that the cases here presented are by no means the only possible 5 year cures of osteogenic sarcomata in the Registry series. It would be better to say that they are the 13 most authentic ones. Other cases especially Case 187 should perhaps also be included and discussed, but there is a limit to interest in the subject if too doubtful instances are brought into question.

I have done my best to be judicial in selecting these, and my colleagues, Doctors Bloodgood and Ewing, have agreed with me that these are the best representatives of cured osteogenic sarcomata and even these are pretty doubtful. If it had not been for Coley's enthusiasm and optimism we should have few to record. Coley has shown us at least that cases considered hopeless may be cured. Even if the hopelessness was due in some cases to the errors of pathologists in mistaking benign tumors for malignant ones, Coley's optimism has been well justified. Whether or not the evidence also justifies his faith in the use of mixed toxins is an academic matter compared with the bald facts that he can furnish evidence of the cure of *apparently* hopeless cases, and that he has furnished evidence of nearly as many cures as all the other surgeons of the country together. He has also furnished evidence of more cures than shown in the above list but some of these other cases are considered by our Committee to be instances of benign giant cell tumor.

From a logical standpoint it seems to me that argument as to the value of the toxins should rest on their postoperative use, for the fact is that over one-half of the successful cases following amputation have had the postoperative use of this agent. To be sure there are few in all.

Further evidence of the value of the mixed toxins will appear in Conner's paper on

Ewing's tumor in the *Archives of Surgery*, but as in these cases there was confusion owing to coincident use of radiation.

Of the present series of 13, in 5 cases amputation must be given the credit alone, unless the Murphy method of diffuse X-ray is claimed to share one of these (Case 29). This idea of Murphy's seems to me to deserve more extended trial.

In two other cases (102 and 501), we do not know whether the toxins were used or not.

In 5 cases they were used before or after operation but in only one of these was radiation not used also.

Finally, in 1 case the cure must be credited to either toxins or radium or both. This case was unique in many respects but clearly histologically malignant.

Another point brought out is interesting. In only 5 cases was the amputation done at the same time as the exploration. In the other 7, exploration was done at least once and in some cases several times before amputation. Even if done only once it was done in a manner which should have caused diffusion of the tumor.

In only 1 case was the amputation done without preliminary incision *but this was the most typical malignant case.*

These facts speak in two ways, either against the malignancy of these particular tumors or in favor of exploration being a harmless procedure.

I have presented what I believe to be the best evidence of 5 year cures so far collected by the Registry. We can continue to guess on the strength of these meager facts or we can co-operate to collect a more complete series.

Shall the College continue the Registry of Bone Sarcoma?

STAPHYLOCOCCUS MENINGITIS SECONDARY TO A CONGENITAL SACRAL SINUS

With Remarks on the Pathogenesis of Sacrococcygeal Fistulæ

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THE purpose of this paper is to report a case of meningitis secondary to a congenital sacral sinus in which recovery followed a lumbar laminectomy with drainage. The case is interesting first on account of the unusual portal of entry, second on account of its bearing on the pathogenesis of congenital sacral sinuses, and third as a case of meningitis in which recovery followed surgical drainage.

The patient, a white male, aged 18, was admitted to the New Haven Hospital on September 10, 1924, complaining of a headache and pain in his back. The patient had always had a sinus in the lower lumbar region of his back. At irregular short intervals there had been a discharge of a watery fluid.

One week before admission he noticed that the area surrounding this sinus was tender. This gradually became worse. After 2 or 3 days his "spine" began to ache. On the day before admission his head commenced to throb. He described this as a "splitting headache." He has had some general malaise and anorexia. He has had no nausea, vomiting, or convulsions. The family history and personal history are irrelevant. The temperature was 101.8 degrees F., pulse 86, and respirations 20 per minute. The patient appeared acutely ill, his face was flushed, and his expression was somewhat anxious. The neck was markedly stiff. The heart, lungs, and abdomen were normal. The biceps and triceps tendon reflexes were normal. The knee jerks and ankle jerks were absent. Kernig's sign was positive. In the midline over the lower lumbar and upper sacral region there was a small sinus, surrounding which the skin was red and tender. A slight amount of thin pus could be expressed from the sinus.

A lumbar puncture was done with removal of 35 cubic centimeters of cloudy fluid under increased pressure. Examination of this fluid showed 1,450 cells per cubic millimeter. The cells were largely polymorphonuclears. A few Gram-positive cocci were seen in a stained smear. The Ross-Jones and Pandy tests were positive for globulin. A culture showed a hæmolytic staphylococcus albus. A blood culture showed no growth after 5 days.

A roentgenogram of the sacrum showed a sacralization of the fifth lumbar vertebra, an irregularity in the fusion of the spines of the fifth lumbar and the first sacral vertebræ, and a flattening of the spine of the first sacral segment with a defect below this level (Fig. 1).

The patient was treated with daily lumbar punctures. The fluid remained cloudy with a cell count varying from 800 to 3,300 white blood cells per cubic millimeter. Cultures were repeatedly positive for staphylococcus albus.

September 20, 45 cubic centimeters of spinal fluid, cell count 990, were removed and 20 cubic centimeters of the patient's blood serum which had been prepared a few hours previously were injected into the spinal canal.

September 21. The patient complained of severe headache and generalized pain which was most severe in his back and legs. The temperature was 101.6 degrees F., pulse 104 per minute. A cell count of the spinal fluid was 3,300 per cubic millimeter.

Clinical diagnosis: pilonidal sinus; spina bifida occulta; staphylococcus meningitis.

Operative note: September 23, 1924. The sinus was injected with methylene blue and excised with the surrounding tissue. The sinus extended through a small bony defect (measuring about 1 centimeter in diameter, Fig. 11) just to the right of the midline at the junction of the first and second sacral vertebræ. The incision was then extended and a laminectomy performed. The spine of the first sacral vertebra was flat. The spinous process was removed from the first sacral segment. The defect was enlarged by removal of the lamina of the first and second sacral vertebræ.

The underlying dura was stained deeply with methylene blue. There was a tuft of granulation tissue just beneath the defect in the spinal column. This was excised after the dura had been opened. The spinal fluid was stained with methylene blue. The dura was left open. A small rubber tissue drain was inserted through the upper part of the incision down to the dura. The wound was closed in layers.

Pathological note: Microscopic examination of the excised sinus showed a lining membrane of several layers of stratified squamous epithelium surrounded by a dense fibrous wall.

The patient's temperature had ranged between normal and 103 degrees F., up until the day of operation. On the following day it fell to normal. There were occasional elevations to 102 degrees F., during the first 14 days after operation, when it became normal and remained so until he was discharged. The drainage of spinal fluid continued for 9 days following operation. The postoperative convalescence was uneventful except for frequent severe pain in his lower back and legs. He was discharged on November 11, 1924. At the time of discharge a neurological examination was negative and the patient was well.

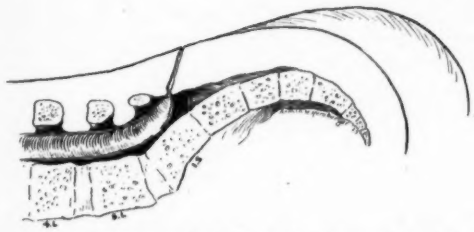

Fig. 1. Diagrammatic drawing showing outline of the lower lumbar vertebræ and the sacrum. There is a sacralization of the fifth lumbar vertebra with an irregularity of the lamina and spinous process. The spine of the first sacral segment is flat, and its laminæ asymmetrical. Below this level the sacral segments are not fused and a bony defect is seen.

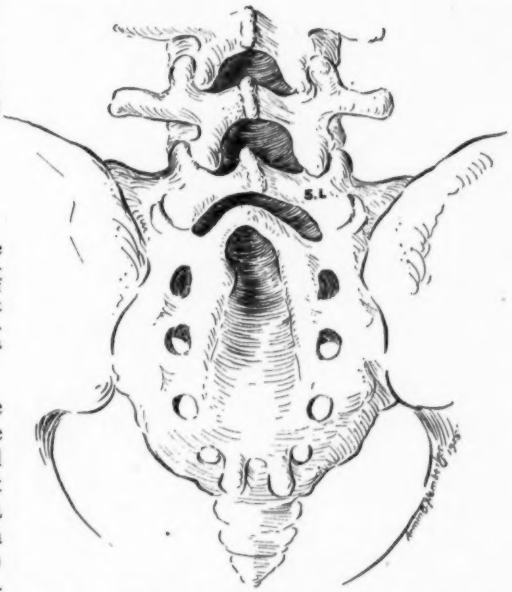

Fig. 2. Diagrammatic drawing showing the sinus extending from the skin surface directly into the subdural space through the bony defect below the lamina of the first sacral vertebra.

This case presented a sinus similar to the usual pilonidal sinus. It was situated over the upper end of the sacrum and was not a blind pouch but extended through a bony defect directly into the spinal canal. There was a history of irregular short intervals during which a thin watery fluid (presumably spinal fluid) escaped freely. This intermittent free drainage is quite possibly responsible for the fact that the patient had not suffered from meningitis at an earlier date.

The meningeal infection was apparently progressing badly under conservative treatment consisting of daily lumbar punctures and a single intraspinous autoserum injection. The sinus was excised and a laminectomy with drainage performed. Following surgical drainage the convalescence was uneventful and the patient was well when discharged from the hospital.

PORTAL OF ENTRY

Although congenital dimples, sinuses, and cysts are commonly observed, a review of the literature shows no instances in which such a sinus has been the portal of entry for a late meningeal infection. These fistulæ are commonly known by the name of pilonidal sinuses.

This common lesion for which surgical advice is sought is a small congenital opening situated in the midline over the coccyx, the sacrococcygeal articulation or over the lower end of the sacrum. These sinuses practically always lead upward and toward the midline. They are lined with stratified squamous epithelium, although this lining membrane is frequently absent due to an inflammatory process. Not infrequently a tuft of hair is seen within these sinuses. As a rule, a spina bifida is not found.

There have been various theories advanced to explain the origin of these fistulæ. These theories have been reviewed by Mallory (1) in 1892 and Stone (2) in 1924. After studying a series of fetuses of 3 to 6 months old, the former author concludes that pilonidal sinuses arise from a persistence of the medullary canal. He states: "These cases show that in fetuses of 3 to 6 months there is very frequently present over the coccyx a canal lined with epithelium—in some cases connected with the skin, in others not, in some situated near the skin, in others near the coccyx. The question naturally arises as to their origin. They may be due either to an extension inward of the epidermis or to the remains of some canal. If due to an extension inward, or, as Lannelongue assumes, to the skin being bound down to the coccyx, why do they not contain the glands and hair follicles with which the epidermis in that region is studded? As regards an extension inward

of the skin, why should it occur here so often and nowhere else? It seems more likely that they are due to incomplete obliteration of a former canal, and extending, as they all do, upward and posteriorly to the coccyx, the medullary canal seems the most likely origin.

"The branchial clefts are closed by the eighth week. As before stated, the medullary canal has been seen open as late as the ninth week. Consequently, the obliteration of the clefts in the one case, and of the medullary canal in the other, must take place at about the same period of intra-uterine life, with this difference, that growth is more rapid and perfect in the upper part of the body, and hence more favorable to closure of the clefts. If, notwithstanding this, sinuses and cysts occur in the neck and about the ears, there is at least an equal chance that they may occur at the lower end of the medullary canal.

"It would seem from a study of the sections from these fetuses that obliteration of the medullary canal takes place at first, and most completely, at the lower end of the sacrum, and extends from this point in both directions.

"As is well known, the spinal cord at first extends the whole length of the vertebral canal; but, as the latter grows the more rapidly in length, the cord rises and the filum terminale is stretched, thus favoring obliteration of the medullary canal at the lower part. The obliteration of the medullary canal between the end of the vertebral anal and the skin apparently frequently takes place in an irregular manner; but, for that matter, the medullary canal in the spinal cord shows frequent irregularities, sometimes existing as a distinct canal, sometimes double, and often showing in sections only as a very irregular clump of cells.

"Undoubtedly the majority of these remnants of the medullary canal become obliterated—only the larger, especially those in which glands and hairs are present, persisting as the depressions, sinuses, and cysts of extra-uterine life; and in all probability it is only the congenital sinuses and cysts which give rise to the suppurating sinuses."

On the other hand Stone believes that the skin and not the neural groove is the source of these sinuses and states: "In spite of these advantages,[1] no satisfactory explanation of the problem has yet been found. It is true that for a time a small cystic remnant of the lowermost portion of the medullary groove persists and is known as the 'coccygeal medullary vestige.' This is lined by a single layer of columnar cells and is doubtless the structure to which Hermann and Toureux have referred. Normally, this little cystic structure has no opening communicating with the skin, and ultimately disappears. Furthermore, its cells are similar in appearance to those lining the central canal of the spinal cord, and in Doctor Streeter's opinion have already become so differentiated that they could not be expected later to give rise to skin, even though the cystic remnant should persist. It is Doctor Streeter's view that pilonidal sinus must be regarded as a special local downgrowth of epithelium, originating from the true skin and not from the medullary groove. The skin in certain regions forms organs like the breast and the external ear, by just such an invagination. No suggestion is as yet advanced as to why such an invagination takes place occasionally in the coccygeal region. In short, beyond the feeling that the skin and not the neural groove is the source of the sinus no facts are present to explain the origin of the lesion."

However, the facts which have been advanced by Mallory are of sufficient importance to throw the weight of evidence in favor of his contention that these sinuses are developmental anomalies resulting from a partial closure of the medullary canal. Furthermore the case here reported shows an irregular fusion of the lamina of the first sacral vertebra, an absence of the spinous process of the second sacral vertebra with a bony defect, at the junction of the first and second sacral segments, and an opening directly into the spinal canal which is additional evidence in favor of the view that these sinuses develop from a failure of the medullary canal to close in the normal manner.

SURGICAL DRAINAGE IN MENINGITIS

In a recent article Dandy (3) has reviewed the literature on the operative treatment of

[1] Doctor Stone refers to the opportunity of having at his disposal the material and opinion of Dr. George L. Streeter of the Department of Embryology, Carnegie Institute, Washington, D. C.

septic meningitis. He states that three types of treatment have been tried: (1) intermittent drainage, by repeated lumbar punctures; (2) continuous drainage from (a) spinal canal, (b) cisterna magna, (c) pontine cisterna, (d) lateral ventricles, (e) subarachnoid space; (3) irrigation of subarachnoid space.

He believes that intermittent drainage can have only slight if any beneficial effect and calls attention to the fact that there have been a few scattered cases of spontaneous cure, which casts some doubt whether many recoveries, apparently resulting from one or another form of drainage, may not have occurred in spite of rather than as a result of the treatment. He believes that mechanical injections may be harmful and even though there is no harmful effect that irrigations sufficiently frequent to be beneficial are impractical.

He advocates continuous drainage from the cisterna magna as the operation of choice and reports a series of four cases in three of which recovery followed such drainage.

In the case, here reported, the pathway of infection was through a congenital sacral sinus into the lower spinal canal with gradual extension of the infection upward. This, of course, gave a direct indication for surgical drainage in this region.

SUMMARY

The sacro-lumbar region is a common site for developmental anomalies among which are included the above mentioned congenital dimples, sinuses, cysts, and tumors. These cases rarely present a connection between the spinal canal and the skin surface.

Other congenital lesions occurring in this region are instances of spina bifida, with all gradations from an unnoticed spina bifida occulta with no external evidence of a defect to a fusion of the spinal cord with the integument. The cases showing a connection between the spinal canal and the exterior do not as a rule survive infancy.

The case, herewith reported, showed a congenital sacral sinus with an underlying spina bifida and a direct connection between the skin and the spinal canal. The occurrence in this case of a pilonidal sinus with an underlying spina bifida and an irregularity in the fusion of the sacral vertebræ is additional evidence in favor of the view that such sinuses are developmental anomalies resulting from a failure of the medullary canal to become completely obliterated.

This lesion had given the patient no cause for worry until the eighteenth year of his life when it served as the portal of entry for a meningeal infection.

A sacral laminectomy with drainage was performed with subsequent recovery from the meningitis.

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HERNIA IN THE BROAD LIGAMENT FROM THE CLINICAL VIEWPOINT

Report of a Case and a Review of the Literature

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ONLY four histories of hernia in the broad ligament have been recorded. It is thought desirable to bring these together and to add a fifth one, thus making the subject more complete.

The extreme rarity of this condition, its seriousness, the necessity for prompt intervention, the value of a more general knowledge of the situation of this form of hernia, which usually comes under treatment for acute intestinal obstruction, and the importance of the treatment which should be employed are the motives for the presentation of this article with the report of the case that came under my care.

ANATOMICAL CONSIDERATIONS

The broad ligaments of the uterus are extensive, fibromuscular planes extending from the lateral borders of this viscus to the walls of the pelvis. The round and the utero-ovarian ligaments form parts of this structure. The peritoneum is thrown over all like a mantle. The round ligament makes a prominence under the peritoneum but it does not project sufficiently to form a meson. Where the peritoneum covers the utero-ovarian ligaments, it forms a short meson and a similar structure, the mesosalpinx, is produced where it surrounds the fallopian tube. One of the more practical points in the consideration of broad ligament hernias is the division of the upper posterior surface of the ligament into two spaces by the utero-ovarian ligament with the border of the ovary. These structures divide this surface unequally into an upper triangular portion, the mesosalpinx, and the lower part, the mesometrium which passes medially to the side of the uterus.

HISTORICAL

No record of this condition was published prior to 1917, although Barnard (1) had stated that hernias may occur in pouches of the broad ligaments and Moynihan also mentioned this possibility.

In 1917 Fagge (3) described two cases, Barr (2) reported a third case in 1920, and Pidcock (5) a fourth one in March, 1924. It is evident that this condition has been observed more frequently than it has been reported. Of the five cases of hernia in the broad ligament, two were found in adventitious pouches and three through openings in it.

Fagge's two cases were incarcerated in pouches within the broad ligaments. One was on the left side, below the utero-ovarian ligament and the other on the right, above. In 3 cases the hernias were through openings, one under the left round ligament and two through openings in left mesosalpinx. The lengths of the incarcerated intestines were 2 inches, 12 inches, 15 inches (author's case) and 8 feet respectively, the last requiring resection.

ETIOLOGY

These histories show one patient unmarried and four married and with children. In one of the latter, obstruction occurred on the fourteenth day following delivery. In this instance the intestine passed under the round ligament. In two other cases the intestine was found in an opening in the mesosalpinx. One patient had fallen down stairs 14 years before operation, but the obstructive symptoms followed straining at stool. Another dated her symptoms from a fall from a chair 15 years before. She never experienced obstruction, only a pain when lying on the left side.

The intestine in these five cases entered the openings from above and behind. This is the plane which the broad ligaments present to the intestines and upon which the intra-abdominal pressure would be exerted in developing a fossa in a weakened spot in the broad ligament or stretching a congenital opening.

It is interesting to consider the causes of these sacculations and stomata. No one discussed this phase of the subject except Pidcock. He investigated the bodies of ten adult females. He could stretch the round ligaments forward, thus demonstrating a thin avascular fold of peritoneum which joined this to the main part of the broad ligament. It required but little force to perforate this membrane with the finger. He suggests, as a possible cause of the condition in his patient that all the structures connected with the uterus were in a relaxed condition as a result of the pregnancy, and that a coil of intestine had, in some manner, ruptured this meso-ligamentous fold. This explanation is plausible, but, in my case, it is probable that congenital stomata existed. This is suggested because both of the broad ligaments contained openings of about the same size which were symmetrical and with smooth edges. The appendix was attached to the lower border of the opening on the right side, and no evidence existed of previous inflammation. It is also probable that the hernia with obstruction in Barr's patient occurred through a congenital opening.

Our knowledge of the embryological development of the broad ligament, gives no clue to the production of congenital windows in this structure. No observation seems to have been made of openings or sacculations of either congenital or postnatal origin, except those cases reported by Barr and myself.

DIAGNOSIS

A pre-operative diagnosis of hernia into the broad ligament has not been made. The diagnosis ordinarily will be that of intestinal obstruction. Vomiting occurred in all of the cases with obstruction. In the cases reported, pain and tenderness were present, simulating in situation and severity that of gall stones, appendicitis, torsion of an ovarian cyst and of an obdurator hernia. The pain may be agonizing or it may be of any grade of severity. Tenderness and rigidity may be present over the left or the right iliac region, according to the situation of the lesion. In only one case could a distinct mass be made out by vaginal or rectal examination. In my case, resistance could be detected, but no tumor could be outlined.

Non-obstructive hernia into the broad ligament may be indicated by periodic pains. When the intestine passes through an opening, certain movements or position of the body may pull on the mesentery inducing the same sort of pain produced by a tug on the intestine when the abdomen is opened under local anæsthesia. The absence of pain during pregnancy is due to the closure of the opening as the uterus ascends. The outstanding diagnostic *fact* to remember is, that in acute obstructive conditions, hernia into the broad ligament is *one* of the possibilities which should be considered.

We are fortunate to be able to illustrate by case histories hernias in these different situations, showing the conditions that may be found and the treatment that was used in each instance.

CASE 1. The author's case. My interest in this subject was stimulated by a patient seen on January 30, 1919. She gave the following history. Mrs. H., age 44, married, was the mother of five children, four of whom were living and well. Her labors were without incident. In 1904 a chair, on which she was standing, tilted suddenly. She was thrown forward, landing on her feet, receiving such a jar, that 3 days later, she miscarried. Following this accident, she had so much pain in the abdomen for a year or more that she could do no lifting neither could she hold a child in her lap. For the past 15 years she could not lie on the left side except when she was pregnant without causing an intense pain which, if the position were not changed, would extend over the entire lower abdomen. Reaching upward caused an acute pain, followed by a sense of weakness, which might last for some time. Sexual intercourse was uncomfortable during the past 4 years. Four labors and two miscarriages have occurred since the accident.

Nothing abnormal was found in the head, chest, heart, or kidneys. There was neither dullness nor tenderness of the abdomen. A vaginal examination disclosed an old perineal laceration and a bilateral cervical tear from which there was a profuse discharge. The uterus was in normal position. Neither tumor nor induration was found to the right or posteriorly. However, there was an indefinable sense of resistance to the left, which could not be definitely outlined. This area was not particularly tender but a dull ache followed the vaginal examination.

On February 1, 1919, under local anæsthesia, the cervical and the perineal lacerations were repaired and hæmorrhoids were removed with clamp and cautery. The abdomen was opened in the median line suprapubically. The hand encountered a mass

of small intestine that was fixed in the left pelvis. Good exposure disclosed 15 inches of intestine projecting through an opening in the mesosalpinx. This opening was approximately 5 centimeters in diameter and was of sufficient size readily to permit the withdrawal of the intestine. It was limited anteriorly by the tube and posteriorly, and to the inner side, by the attenuated utero-ovarian ligament and the ovary. The aperture was closed with chromic catgut. The needle was passed very close to the edge of the opening, which drew the tube to the side of the uterus. Further examination of the pelvis located a similar opening of the same size in the right broad ligament. This aperture lay between the tube and the utero-ovarian ligament. No intestine occupied this opening, but the appendix extended parallel with, and was attached to, its lower margin. The proximal end of the appendix was attached to the posterior edge of the hernial opening, the end pointing to the right. It was removed and the opening in the mesosalpinx obliterated as on the left side. A survey was made of the pelvis and since it was found that the left tube had become cyanotic from impairment of its blood supply it was removed. The right tube was examined again and its circulation seemed unimpaired.

The convalescence was uneventful, the patient returning home at the end of 2 weeks. However, on the way from the hospital, she developed an intense pain in the right iliac region. This pain,with an elevated temperature, continued for a week. A vaginal opening was then made into the right broad ligament at the point of induration and tenderness. This released a considerable quantity of serous exudate but no pus. The patient made a rapid recovery and has been well since. This postoperative disturbance was doubtless due to interference with the blood supply of the right tube.

It is an interesting speculation as to the length of time the intestine had occupied the opening in the broad ligament. It is conceivable that with the fluid content of the small intestine, such a condition was possible without obstruction occurring during the period of years she suffered following the injury. The fact that she was comfortable when pregnant and has been completely relieved since the operative obliteration of these stomata, supports the inference that the intestine probably occupied the ostia in the broad ligament the greater part of this time, for when she lay on her left side she always had pain.

Case 2 (Pidcock). Mrs. V., age 34. Fourteen days previous to entering the hospital, she had a normal labor, the pregnancy and puerperium being without incident. While bathing her baby, she was seized with sudden and violent pain in the region of the navel. The pain was continuous and very acute. Two hours later vomiting began and recurred at intervals all afternoon. No fæces or gas passed after the onset of symptoms. A ventral hernia, never larger than a pigeon's egg, had existed on the left side for 3 years. This always disappeared when she lay down. It was not present at the time of examination and was probably inguinal. Her temperature was 97.5 degrees, her pulse rate 65 and very weak. She complained all the time of agonizing abdominal pain. The face was cold and beaded with sweat. The abdomen was lax with no distention nor visible peristalsis. Some fluid was present in the flanks. Slight tenderness and rigidity were discovered in the lower part of the left iliac fossa. No mass was felt.

The diagnosis lay between an acute perforation and acute intestinal obstruction. The latter seemed more likely.

On opening the peritoneal cavity, free bloody fluid escaped, the abdomen being apparently filled with plum-colored coils of small intestine. The cæcum was collapsed but otherwise healthy. A band was felt rather to the left side and in front of the uterus. This was divided between forceps relieving thereby the strangulated gut. A small artery was distinctly seen in the center of the cut band. Careful investigation showed the strangulating agent to be the left round ligament, one end of which was traced to the internal abdominal ring and the other directly to the uterus. The ligament measured 4 inches in length, and, before division, the middle 2 inches were quite free from the broad ligament. There appeared to be no evidence of old pelvic inflammation, such as might give rise to adventitious bands simulating the round ligament. The coils of strangulated intestine were evidently on the verge of gangrene and required the excision of 8 feet of the small gut. The convalescence was stormy and, on the seventeenth day, necessitated the reopening of the abdomen with drainage of an abscess localized between coils of intestine. Fourteen days later a perinephric abscess required evacuation. From this time on convalescence was without further incident.

Case 3 (Barr, 2). Mrs. L. H., age 44. Mother of seven children, youngest seven years. She had had four miscarriages and had not menstruated within 8 years. Her previous health had been good. On January 15, 1920, she was suddenly seized with a severe pain in the epigastrium. This was more severe to the left of the median line and radiated downward to the left pelvis. Her physician found the most sensitive point to be to the right of the median line and over the gall bladder. The pain was general throughout the abdomen although more severe at the point named. It was constant with accentuations at short, irregular intervals. Nausea and vomiting were prominent symptoms. Morphia was administered for the relief of pain. A diagnosis of gall-stone colic was made and concurred in by three physicians.

Barr saw her on January 17, the third day following the inception of the attack. At this time the patient was suffering excruciating pain throughout the abdomen, although it was most intense to the left of the median line, in the left pelvic region. There was excessive and persistent nausea with vomiting on taking food or fluids. Moderate abdominal rigidity was present. There had been no

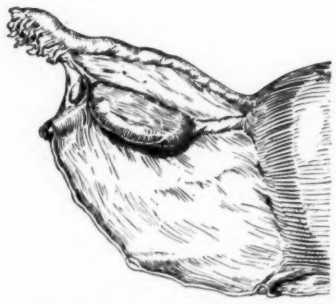

Fig. 1. Adopted from Solotta-McMurrich. The division of the upper posterior surface of the ligament into two spaces by the utero-ovarian with the border of the ovary, with the result that this surface is divided unequally into an upper triangular portion, the mesosalpinx, and the lower part, the mesometrium which passes medially to the side of the uterus.

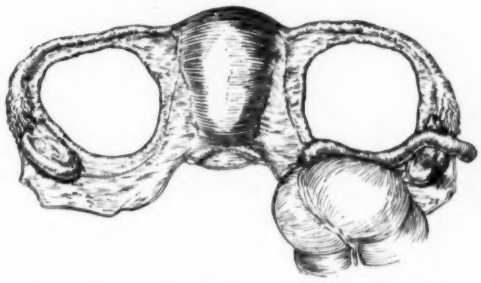

Fig. 2. Each broad ligament presented a window 5 centimeters in diameter limited anteriorly by the tube and posteriorly by the attenuated utero-ovarian ligament and the ovary. The proximal end of the appendix extended parallel with and was attached to the posterior edge of the window of the right broad ligament, the distal end pointing to the right.

bowel movement for 48 hours. Digital examination was negative. The temperature was 98, the pulse 78 and of good volume. Heavy albumin, with granular and hyaline casts, was present in the urine.

On the third day she was operated upon. A suprapubic, median incision allowed a considerable quantity of cloudy fluid to escape. Inspection revealed about 12 inches of the small intestine passing through an opening in the left broad ligament and tightly constricted. Traction failed to dislodge the imprisoned gut. The aperture was enlarged by tearing with the finger, releasing the intestine. Hot saline sponges restored the circulation in the gut. Considerable hæmorrhage occurred as the result of rupture of the ovarian vessels where the opening in the broad ligament was enlarged. Relief of pain, nausea, and vomiting was immediate and complete. The patient made an excellent recovery.

CASE 4 (Fagge's first case). Mrs. Y., age 61. The only history of any accident was a fall down stairs in 1902. Beyond a hæmatemesis in 1905, there was no history of any abdominal trouble. She was the mother of five children. On December 9, 1917, while straining at stool, she was suddenly seized with abdominal pain. This pain was referred to the left iliac region. She vomited several times. Nothing was to be made out on abdominal examination, except marked tenderness low down in the left iliac region. The tongue was clean but her aspect was anxious. No exact diagnosis was attempted before operation. Conditions considered were torsions of an ovarian cyst, strangulated obdurator hernia and mesenteric thrombosis. When under the anæsthetic, a vaginal examination detected fullness of the left vaginal fornix and a rectal examination confirmed the presence of a mass in Douglas' pouch.

Abdominal incision exposed small intestine, and lower down and to the right a coil of ileum which was distended and purple. It could not be drawn out and was evidently held down in the pelvis. This and another collapsed coil were traced down to the left side of the pelvis, where they were caught and held tensely as they passed through a small hole in the peritoneum. They were obviously the afferent and efferent links of the strangulated loop, which could be seen and felt under a layer of peritoneum, filling up the left half of the pelvis. It was thought at first that the orifice was the entrance to the intersigmoid fossa, but the peritoneum passed over the pelvic brim to the left, and below, its margin was continuous with a tense layer of peritoneum passing on to the side of the uterus. The margin of this opening was divided by scissors, allowing the distended loop of the ileum to be withdrawn, when it was found that this loop had passed from behind forward into the broad ligament, and, filling up Douglas' pouch, had formed the mass which was palpable through the rectum and vagina. The loop actually strangulated was 10 inches long. The gut was viable. The opening in the broad ligament just below and median to the ovarian ligament, was closed by a continuous catgut suture. A large rubber drain was passed into Douglas' pouch. In February, 1917, the patient had another severe attack of left-sided abdominal pain. This recurred in March. The abdomen was reopened at Guy's Hospital on March 12, 1917, and extensive adhesions between the scar and the lower ileum were freed. The opening to the left broad sac had remained closed.

CASE 5 (Fagge's second case). Miss P., age 49, was seized with abdominal pain on November 30, 1917. She vomited at intervals. The next morning she did not appear acutely ill, but she vomited occasionally and the pain was not severe. The next day she fainted. On December 3, she continued to vomit occasionally and the pain located in the middle of the abdomen was severe. There was now slight rigidity and tenderness over the right rectus, slightly internal to McBurney's point.

A diagnosis of appendicitis was made. Abdominal incision exposed a healthy appendix. The small intestine was somewhat distended with an abnormal amount of clear fluid in the peritoneal cavity. A coil of the lower ileum was fixed to the back of the right broad ligament, leading to a blue, cyst-like body in the substance of the broad ligament. The upper margin of the hernial orifice in the broad ligament was cut with scissors, releasing 2 inches of ileum. The operator could now demonstrate that the pouch into which the intestine had passed was above the ovary and its ligament, and that by the division of its neck it had been converted from a saccular pouch into a shallow fossa incapable of encouraging a similar retroperitoneal hernia. The operator did not think its obliteration by suture necessary.

The patient made an uninterrupted recovery.

TREATMENT

Treatment resolves itself in cases which develop acute obstruction into the release of the incarcerated intestine and the obliteration of the sac or fenestra. In Fagge's first case a large pouch was closed by suture. Several months later, when the abdomen was reopened, it was noted that the hernial opening had remained closed. In his second case, the fossa was so shallow that it disappeared when the constriction was cut. Hernias under the round ligament should be released by cutting the constriction and repaired as indicated by the condition found. When the intestine passes through an opening in the mesosalpinx, the tube may be resected if the patient is past the menopause. Or, if pregnancy be possible, the broad ligament may be cut below the fimbriated end, liberating the tube and permitting it to swing freely in the pelvis. I doubt the propriety of suturing the opening, if it is large, as the blood supply of the tube may be impaired by angulation. It is desirable to perform these operations under local anæsthesia when intestinal obstruction has occurred because of greater safety to the exhausted and prostrated patient and because of the "negative abdominal pressure" which may be secured.

SUMMARY

1 Broad ligament hernias are extremely rare.

2. The etiology of broad ligament pouches and fenestra is unknown.

3. Congenital malformation or postnatal trauma may be the contributing factors.

4. Hernias in the broad ligament frequently produce obstruction, and this obstruction is the usual cause of symptoms and the necessity of intervention.

5. These hernias more frequently occur in women who have borne children, but may follow labor or may be found in primiparæ.

6. The fact that hernias in the broad ligament may cause disability or obstruction demanding surgical relief, must be kept in mind.

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DEPARTMENT OF TECHNIQUE

A METHOD OF PARTIAL GASTRECTOMY WITH TELESCOPIC ANASTOMOSIS

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I AM persuaded that the ideal method of anastomosis after partial gastrectomy is an end-to-end union between the stomach and duodenum. The stomach then empties directly into the duodenum, which has a mucosa and alkaline fluids particularly adapted for handling the erosive chyme. Secondary marginal ulcer is then rarely to be feared. The normal intestinal current lines are maintained. The duodenal hormone is formed under conditions that approximate the normal. There is no reason for the secondary degeneration of the pancreas mentioned by Borodenko as following a lower point of anastomosis. The main intestinal stream is not shunted from the stomach to the jejunum and therefore reflux into the eliminated duodenum with distention and possible opening of the duodenal stump or stagnation, inflammation, ulceration cannot occur. Oschner's muscle, the sphincter of the duodenum, and the barrier against overloading of the jejunum and ileum may be retained to regulate the emptying of the stomach and maintain the ileopyloric reflex. The jejunum is not disturbed and secondary symptoms from its adhesion, angulation, or torsion are eliminated. The mesentery of the transverse colon is not opened and herniation into the lesser peritoneal cavity is not to be feared. Large or small intestinal loops that favor obstruction or herniation are not produced. A secondary entero-entero-anastomosis is not required. A single zone of the digestive tube is subjected to suture, instead of two or more zones. Finally, my personal late results from end-to-end suture have been satisfactory. Many reasons, therefore, confirm the belief that, when it is feasible, an end-to-end anastomosis is the most nearly physiological and anatomical method in partial gastrectomy.

The objections to an end-to-end union between the stomach and duodenum are:

1. The disproportionate size of the openings in the stomach and duodenum producing technical difficulties, especially when large resections of the stomach are necessary.
2. Excessive tension with the danger of secondary separation and leakage at the suture line.
3. Secondary narrowing of the new opening with obstruction.
4. Difficulties in mobilizing the duodenum with danger of hæmorrhage, leakage, or damage to the pancreas, the pancreatic, or biliary ducts.

Difficulties in uniting the cut end of the duodenum with the stomach have been emphasized by the use of clamps and the failure of the operator to attempt that which, at the onset, seems almost impossible, the fitting together of the edges of openings very different in size. Under peristaltic contraction, however, the diameter of the stomach closely approximates that of the relaxed duodenum. By making a transverse instead of an oblique section of the stomach, by stretching the end of the duodenum to its greatest diameter, by spacing the sutures so that they are three or four times as far apart on the gastric as on the duodenal side, we have repeatedly been able to make a satisfactory end-to-end anastomosis when from one-half to two-thirds of the stomach have been removed. Expedients employed, largely in earlier cases before we discovered the feasibility of a pure end-to-end union, included modifications of the Billroth I method, in which the duodenum was implanted at the upper angle or middle of the gastric incision, and the enlargement of the duodenal opening by secondary incisions through the superior or inferior wall (Fig. 3). These methods are useful to meet conditions found in individual cases. With proper mobilization of the duodenum and stomach, it is rare that the openings of the stomach and duodenum cannot be apposed when not more than two-thirds of the stomach have been removed.

Kocher over 20 ago years described the mobilization of the duodenum by dividing the peritoneal reflection on the right side. With the stomach, mobilization depends largely on sufficient freeing the lesser curvature, and William Mayo has emphasized the value of a high ligation and division of the gastric artery. Tension after the

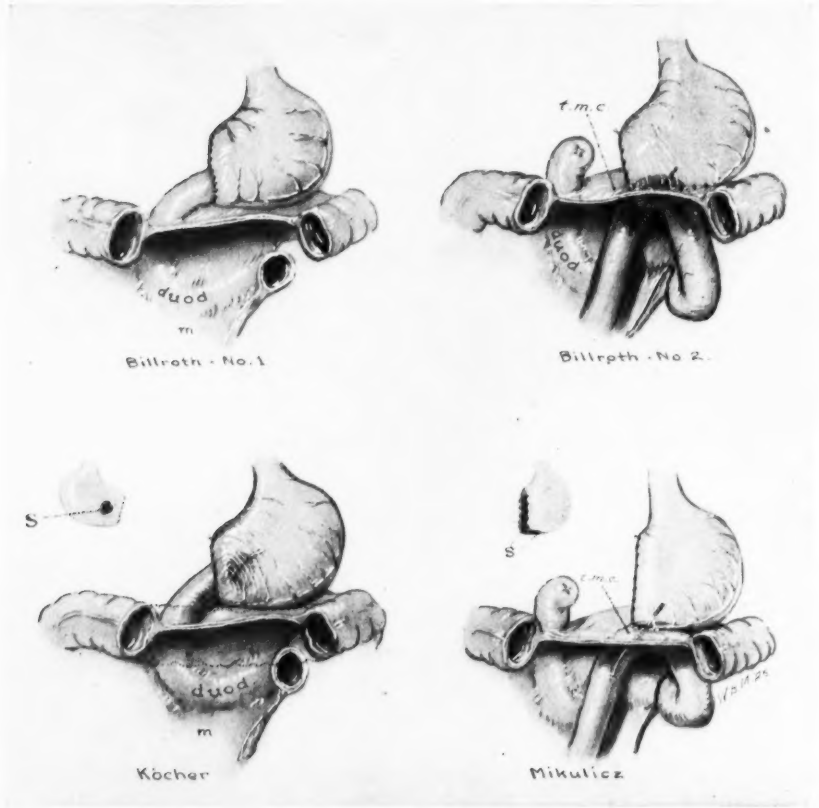


Fig. 1. Older methods of partial gastrectomy. Billroth I end-to-end union with duodenum anastomosed in lower part of gastric incision. With original technique, this was followed by leakage at so-called "fatal angle." The opening may contract and become occluded. Billroth II. End of stomach and duodenum closed followed by separate anterior—or, as shown, a posterior gastrojejunostomy. Kocher method. A modification to avoid the fatal angle of Billroth I. End of stomach closed, end of duodenum anastomosed to posterior wall of stomach. Now practically obsolete. Mikulicz method designed to obtain dependent drainage. End of stomach closed, jejunum anastomosed to adjacent greater curvature. Rarely used. *S.*—Stoma; *T. M. C.*—Transverse mesocolon.

anastomosis may be relieved by bringing back over the line of suture the reflected peritoneal layer, and tacking it to the anterior wall of the stomach so as to hold the gastric stump well to the right. Much support also may be obtained by uniting the divided edges of the gastrohepatic and the gastrocolic omenta to their respective duodenal extensions, and the line of suture in the serosa may be further reinforced by a covering of omentum. We have not seen separation of the suture lines from tension, and with the use of proper mobilization and support it should rarely occur.

Altogether, we would estimate that tension will prevent a safe end-to-end suture in less than 10 per cent of patients after partial gastrectomy. Secondary closure of the anastomotic opening has occurred after gastrectomy by the Billroth I method, and after various forms of gastro-enterostomy. It is our opinion that in the former operation it has depended largely on the failure of the surgeon to use the maximum opening that the duodenum permits. The use of clamps which tend to fix the diameters of the stomach and duodenum, as well as to devitalize their walls, may be blamed for some of the limitations that have marked the new opening. The fires of medieval surgery are still alight, for those who would divide the stomach only by strangling, crushing,

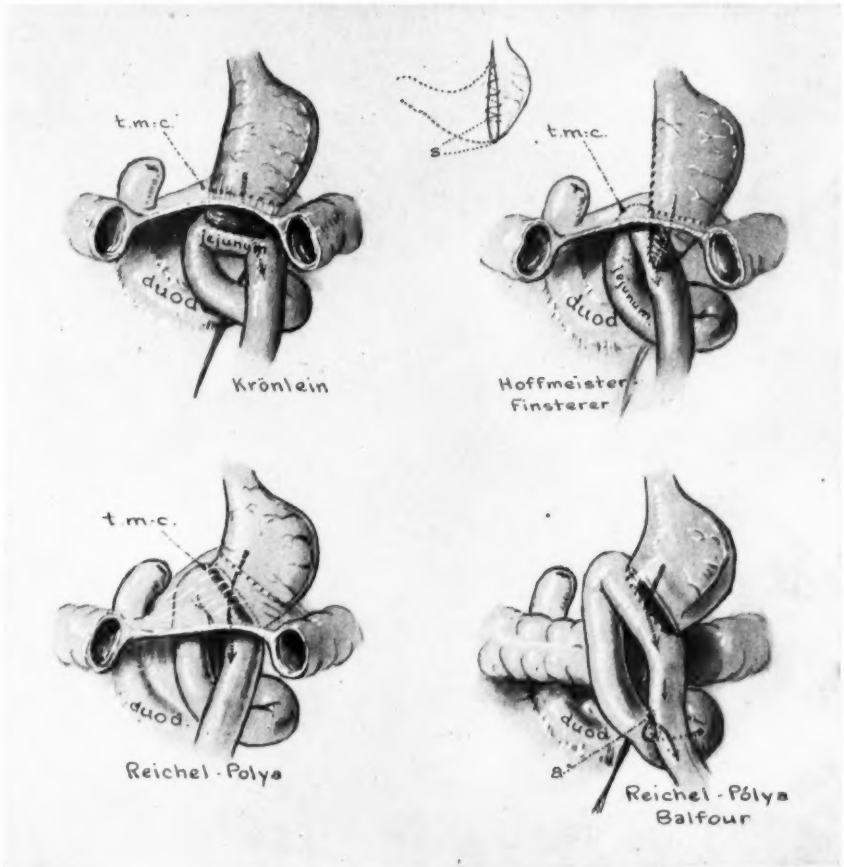


Fig. 2. More recent methods of partial gastrectomy. Kroenlein method, a low section of a narrow stomach was made and the small end of the stomach united to the side of the jejunum. This has been supplanted by the more radical Reichel-Pólya and Hoffmeister-Finsterer methods in which care is taken to have the afferent loop of jejunum higher than the efferent. Hoffmeister-Finsterer method, a large, very oblique, gastric resection with removal of part or all of lesser curvature. Large retrocolic anastomosis with edge of lower part of gastric incision united to side of jejunum. Developed for gastric ulcer by Finsterer but considered by many surgeons unnecessarily radical. Reichel-Pólya method, an isoperistaltic, retrocolic union of the end of the stomach to the side of the duodenum. Balfour's modification of the Reichel-Pólya operation, an isoperistaltic antecolic union of the end of the stomach with the side of the colon. Used to avoid the tension and technical difficulties of the retrocolic union, particularly if the residual portion of the stomach is small, high, and rather fixed. To avoid reflux distention of the proximal loop an entero-enterostomy has been added. *T. M. C.*—Transverse mesocolon; *S.*—Stoma.

and burning. The fallacy of aseptic operations upon the alimentary tract with a crushing clamp will be corrected as operators note the bacteria forced through the intestinal walls in crushing.

In partial gastrectomy, the late dangers and complications of an associated gastrojejunostomy should be eliminated if possible. Unless necessitated by the character of disease, a transverse resection so that peristaltic waves reach the end of the lesser and greater curvature simultaneously is desirable. Oblique resections with sacrifice of a disproportionate portion of the lesser curvature may, as after V-shaped resection of lesser curvature, be followed by motor irregularity. In the

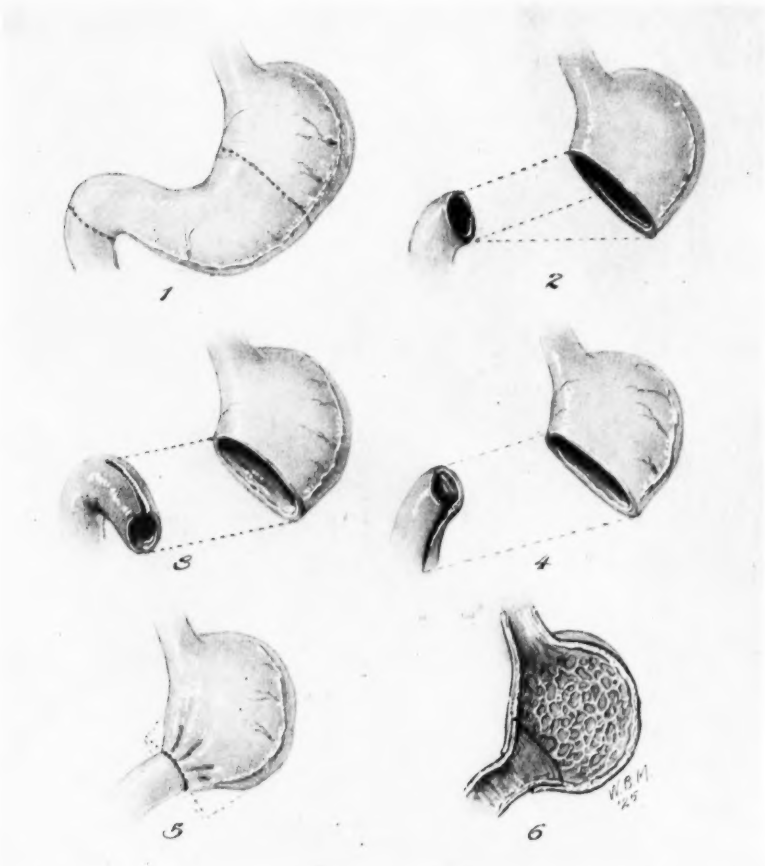


Fig. 3. Partial gastrectomy with end-to-end union with expedients for producing a large stoma. *1*, Portion of stomach to be resected. *2*, End of duodenum stretched to produce direct end-to-end union. We have found this entirely feasible in a number of cases. *3*, Superior or *4*, Inferior edge of the duodenum split to form a large duodenal opening for direct end-to-end anastomosis. *5*, Telescopic anastomosis, the puckering of the stomach is exaggerated in the picture. *6*, Telescopic anastomosis, section showing the large funnel-like stoma produced.

anastomosis, the lines of suture should, of course, be strong and well reinforced. For over a year we have employed a method of telescopic anastomosis.

TELESCOPIC ANASTOMOSIS

The method of telescopic anastomosis to be described has been used in ten cases; nine times for ulcer, and once for ulcerated carcinoma of the greater curvature. One patient died from postoperative hæmorrhage. The postoperative history of eight patients has been satisfactory. Instead of an end-to-end junction of stomach and duodenum, the duodenum is turned into the open end of the gastric stump after a high resection of the gastric mucous membrane and the outer serous surface of the duodenum united to the inner surface of the denuded muscularis of the stomach. The entire thickness of the cut end of the duodenum is united to the gastric mucosa. The superior strength of a union between muscle and peritoneum was observed by some of the early abdominal surgeons, who, after experimentation, interposed peritoneum

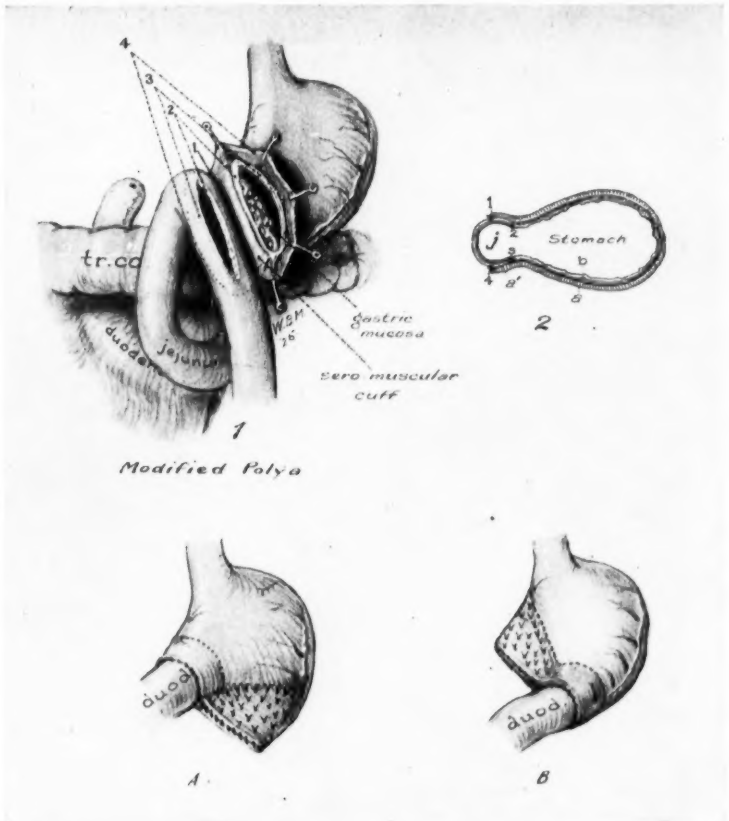


Fig. 4. Telescopic anastomosis showing adaptations of the method that may be used in end-to-side, side-to-side, and end-to-end anastomoses of the stomach and bowel. *1*, Pólya type of gastrectomy with telescopic union. The gastric mucosa is resected to a higher level and the redundant seromuscular cuff has its inner denuded surface applied to the serous coat of the jejunum, around the stoma. *2*, Anastomosis shown in cross section. The edge of the jejunal opening is united to the gastric mucosa at *2* and *3*. The denuded seromuscular cuff of the stomach is shown partially surrounding and attached to the outer wall of the duodenum at *1* and *4*. *A*. Modification of telescopic anastomosis after partial gastrectomy with reduction in the functional capacity of the stomach by extensive resection of the gastric mucous membrane. The gastric mucosa has been removed from within the dotted lines, the duodenum invaginated into the upper angle, united to the mucous membrane of the stomach, the mucous closure completed to the greater curvature and the redundant seromuscular coats of the stomach apposed by internal, or by mattress sutures. *B*, Similar telescopic implantation of the duodenum at the lower angle of the incision.

between the edges of the abdominal incision to prevent postoperative hernia. The duodenum is thin and easily torn, and approximates in thickness the mucous layer of the stomach. The smallest circumference of the stomach, the inner, is apposed to the largest circumference of the duodenum, the outer. The telescopic union, therefore, has the advantage of strength, reinforcement, and mechanical adaptation. The depth of invagination is from 2 to 6 centimeters, and varies with the available length of the duodenal stump, and the amount of stomach resected.

Technique. Through a convenient incision the abdomen is explored, the lesions determined, and

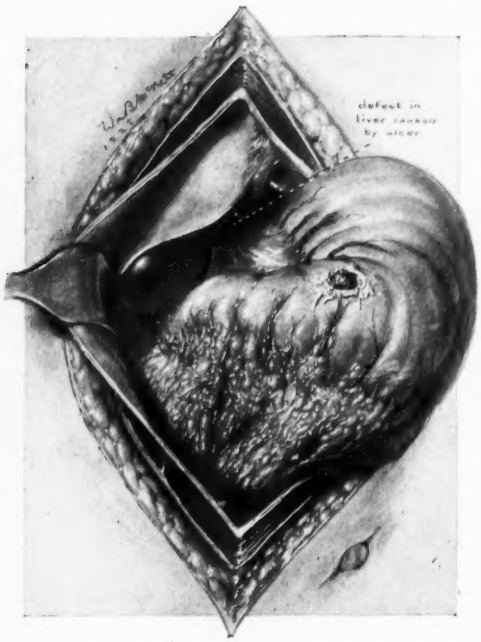
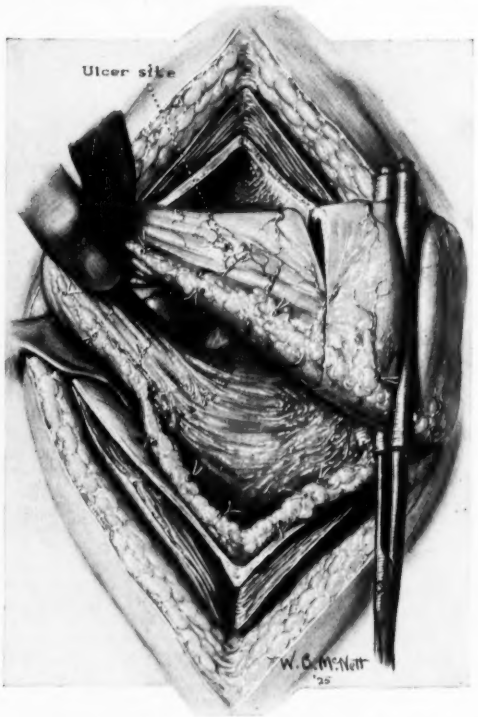


Fig. 5. Ulcer of the anterior wall of the stomach attached to and invading the liver. Case 9.

the operation planned. In the gastrectomy three lines of division of the alimentary tube are selected, their position depending upon the pathological conditions that are found. The first is a transverse line across the stomach well above the area of disease, where the mucous membrane is to be divided. The second line parallel with, and 2 to 7 centimeters below, the first, is where the outer layers of the stomach are to be divided. The distance between lines one and two is the depth of the proposed invagination of the duodenum into the stomach. Line three lies below the area of disease and indicates the plane for the division of the duodenum.

The stomach and upper duodenum are liberated in the usual way. The peritoneum over the duodenum is divided near the pylorus and reflected to the right, the upper duodenum freed usually to the pancreaticoduodenal angle, with very careful ligation of all bleeding points. Adhesions to the pancreas and other tissues, and the vascularity of the region may render this part of the operation troublesome. In freeing the lower end of the stomach, the gastrohepatic and gastrocolic omenta are divided between ligatures to a plane at least 1 centimeter above line one. The stomach and duodenum having been sufficiently mobilized and all bleeding arrested by ligatures, a soft or rubber-covered clamp is placed across the stomach just proximal to line one and a second clamp just distal to line two. After suitable isolation by pads the stomach is divided proximal to the second clamp (Fig. 6), and the mucosa removed from the open proximal part of the stomach up to the level of clamp one. If there has been no preceding gastritis in this zone, the mucosa will be found lightly attached to the overlying muscularis from which it is easily separated and removed by a pair of Mayo scissors (Figs. 7, 8). If adherent, the mucous membrane may quickly be removed up to the line formed by the first clamp, by a large sharp bone curette (Fig. 9). The pyloric segment of the stomach is reflected to the right, and the left serous face of the duodenum several centi-



Figs. 6 to 19. Telescopic gastrectomy. Figure 6 shows the stomach and duodenum have been liberated and all divided vessels secured by ligature. A rubber-covered clamp has been applied to the stomach on the line of proposed mucous membrane division and the stomach divided several centimeters below this point. A clamp to avoid leakage may be applied to the lower segment of the stomach which is reflected to the right.

meters distal to the proposed line of duodenal division stretched across and united to the posterior musculoserous edge of the open stump of the stomach by means of guide and continuous sutures (Fig. 10). Before introducing the continuous suture, the relative breadth of the stomach and duodenum at the suture line is noted. If the former is three times as wide as the latter, it is obvious that the bights of the continuous suture should be spaced three times as far apart on the gastric as on the duodenal side. This rule is to be observed throughout the anastomosis. The introduction of several preliminary spacing sutures is helpful. The lower section of the stomach is now removed by dividing the duodenum along line three. Absolute hæmostasis on the duodenal side having been obtained, the remaining soft clamp on the stomach is gradually opened and bleeding vessels ligated when the clamp may be removed or reapplied at a higher level. The next step is to turn the free end of the duodenum into the open end of the stomach and unite it to the edge of the gastric mucosa. In this step also guide and spacing sutures will aid in the proper introduction of the continuous suture. These sutures pass through the entire thickness of the duodenum and the mucosa of the stomach (Figs. 11, 12, 13). An intermediate row of interrupted sutures to unite the outer surface of the duodenum and the inner surface of the exposed muscularis

Fig. 7. The gastric mucous membrane is being separated from the muscular coat by curved Mayo scissors.

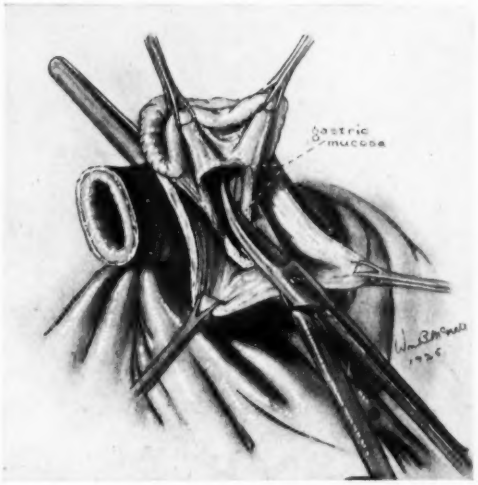


Fig. 8. Telescopic gastrectomy continued. The separated cuff of gastric mucous membrane is divided on the line formed by the proximal clamp.

of the stomach is usually desirable to obliterate the "dead" space and control oozing. The anterior edge of the mucosa of the stomach is now united to the anterior edge of wall of the duodenum finishing this continuous suture, after which the intermediate interrupted and external continuous suture lines are completed on the anterior face of the anastomosis (Fig. 14). The operation telescopes a section of the duodenum 2, 4, or more centimeters long within a section of stomach denuded of its mucous membrane. The entire thickness of the duodenal edge is united edge to edge with the gastric mucosa and surrounded by the thick musculoserous coat of the stomach. Thus the duodenum, which often is thin, rather friable, and easily lacerated by sutures, has a wide reinforcement by the thicker and tougher gastric wall. We have used No. 00, or No. 0 chromic catgut for all sutures. Obviously, from the elasticity of the tissues the cuff of mucous membrane resected from the stomach may be much longer than the invaginated portion of duodenum. If desired the shape of the seromuscular cuff may be modified as by making a long posterior and a short anterior flap. Properly performed, the telescopic anastomosis produces a union with little wrinkling or external evidence of redundancy. The larger gastric end fits about the duodenum in a surprising smooth and accurate way (Fig. 15). Viewed from the inside of the stomach, on the cadaver (Fig. 16), the normally

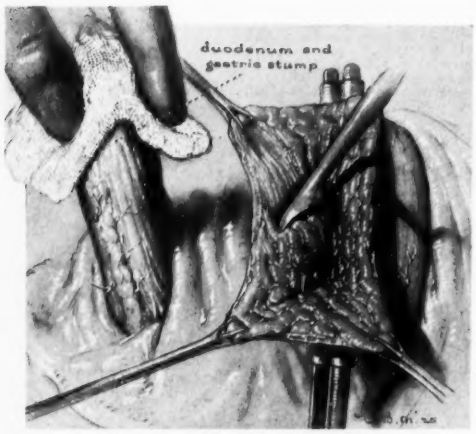


Fig. 9. If the gastric mucosa is adherent it may quickly be removed by a large sharp bone curette. The soft clamp applied to the stomach causes the mucosa to be divided by the curette along a straight line.

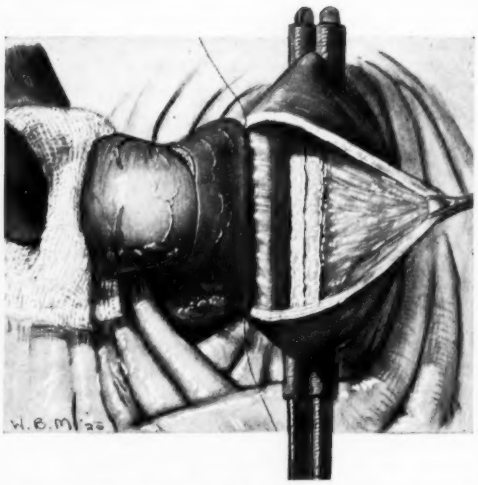


Fig. 10. Showing edge of mucous coat of the stomach and protruding denuded muscular coats. Posterior seromuscular suture in place.

plicated mucosa of the stomach fits well with the duodenal edge, and a smooth funnel-like opening from the stomach is formed with a large lumen.

The union is reinforced by uniting the gastrohepatic omentum superior to the line of anastomosis and the gastrocolic omentum inferior to the line of anastomosis to corresponding peritoneal and omental reflections of the duodenum, in this way covering the pancreas and closing the lesser peritoneal cavity. The portion of the peritoneum reflected to the right in mobilizing the duodenum usually can be brought over the line of anastomosis and tacked to the anterior wall of the stomach to aid in holding the stomach well to the right (Fig. 17).

As an excess of gastric mucosa is removed, the operation produces the effect of a higher gastric resection upon the gastric acidity. With many adhesions about the duodenum, or a very fixed duodenum, the operation is tedious and difficult, and in certain cases should not be attempted especially by the tyro in gastric surgery. Variations of the method may be used for gastro-enterostomy, other forms of gastrectomy, and to reduce the functional capacity or acidity of the stomach as indicated in Figure 4. In the ten cases here reported an anastomosis of the type shown in Figure 3, *5*, was used in nine, a long posterior and short anterior flap in one.

Hæmostasis should be absolute. In mobilizing the duodenum every bleeding vessel should immediately be ligated. Care should be taken in the first posterior row of sutures that the pancreaticoduodenal artery, running in the groove between the pancreas and duodenum, is not transfixed. Serious bleeding may follow a needle puncture of this vessel. Exposure or resection of parts of the cortex of the pancreas, as a rule, is harmless. In several instances we have divided the duodenum first and placed the posterior row of seroserous sutures before resecting the stomach (Figs. 18, 19). An objection to this is the damage that may occur to the line of suture in resecting the mucous membrane from the stomach.

Anæsthesia. One patient received local anæsthesia supplemented by a little ether. Nine of the ten patients received spinal anæsthesia. As the duration of spinal anæsthesia is only 60 to 90 minutes, it was supplemented in 8 cases by local anæsthesia with procaine-adrenalin, and in one case by 24 cubic centimeters of ether. The 200 cubic centimeters or more of the local anæsthetic solution used not only reinforced and extended the action of the intradural injection but also stimulated the patient and protected the vaso depression from the root anæsthetic. All of the patients were more or less narcotized by preliminary scopolamin-morphine injections. In one patient a thyrotoxic crisis resulted from the use of adrenalin in the local anæsthetic solution. Three of the patients had gastric ulcer, six duodenal ulcers, one an ulcerating carcinoma of the stomach. A small cigarette drain was used in three cases on account of oozing surfaces. I am entirely responsible for the fatality of the series.

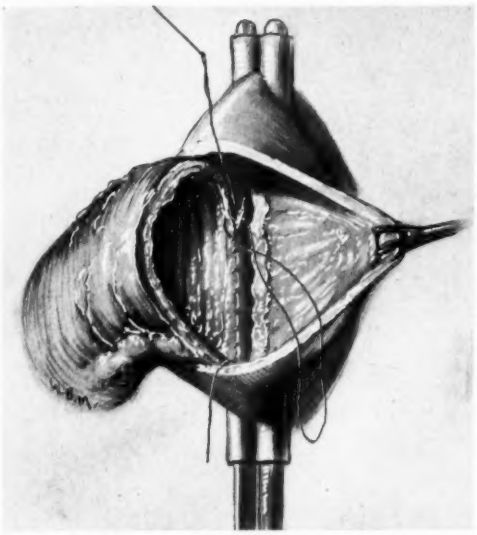


Fig. 11. Union of the edge of the duodenum to the edge of the mucosa of stomach by continuous suture. First row of sutures introduced. Interrupted guide and spacing sutures not shown.

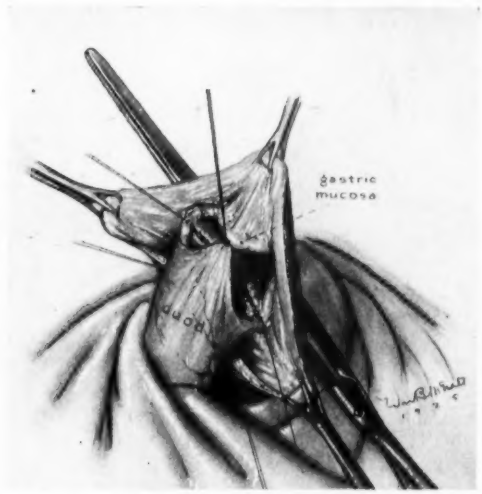


Fig. 12. Edge of duodenum partially united to edge of mucosa of stomach. Interrupted guide and spacing sutures shown.

The operation was in a distant city and the wound was closed with a small gauze wick and with insufficient search for an oozing point. Then my bad advice prevented the local surgeon from reopening after I had left until the patient was *in extremis*.

With low acid values or offensive gastric contents we administer dilute hydrochloric acid before the operation and inject a 0.5 per cent solution through a hypodermic needle into the stomach and duodenum before opening the viscus. This, we believe, reduces the chance of infection.

CASE 1. Duodenal ulcer with subacute perforation to pancreas. Gall stones in appendix. Telescopic partial gastrectomy, appendectomy. Recovery.

Mr. Daniel E., referred by Dr. J. M. Cunningham, age 35. Patient was anæmic, and had had digestive symptoms for 2 years with marked increase in symptoms for the past 3 months.

Operation, May 27, 1924. Spinal anæsthesia was used—6 centigrams of alcoholized stovain through the twelfth dorsal interspace, reinforced by 200 cubic centimeters of 1 per cent adrenalinized procaine injected locally. A duodenal ulcer with subacute perforation and dense adhesions to pancreas was found on the posterior wall of the second portion of the duodenum. The pylorus was almost occluded. There were faceted gall stones in the appendix; one, 1 centimeter in diameter and six, about 3 millimeters in diameter. A partial gastrectomy with telescopic resection was carried out with three rows of No. 0 and No. 00 chromic catgut sutures. The operative difficulties were greatly increased by the adhesions to the pancreas. The appendix was removed. The patient's recovery was uninterrupted, and December, 1925, he reported that he was eating everything, and free from gastric symptoms. At this time he was thin and showed evidence of pulmonary tuberculosis.

CASE 2. Gastric ulcer of lesser curvature with subacute perforation. Telescopic gastrectomy under local anæsthesia. Recovery.

Dr. D. J. C., referred by Dr. Louis Brinton, age 48; dentist, a previous alcoholic, had suffered from digestive disturbance for 3 years.

Operation, June 2, 1924, under local anæsthesia with 600 mils of 1 per cent adrenalinized procaine. A Perthes incision was made. A gastric ulcer with a crater measuring 2 by 1 centimeters was found on the lesser curvature of the stomach near the pylorus, that had penetrated the muscular coat, and was covered by adherent omentum. The first part of the duodenum and about one-fourth of the stomach were removed, the duodenum being first divided. A modified telescopic union with a long posterior and short anterior flap was used, with continuous and interrupted sutures of fine chromic catgut. The tissues were very vascular and friable. A hæmatoma requiring drainage developed in the abdominal wound, and a postoperative cough was followed by an incisional hernia. The gastric symptoms have been relieved by the operation (January, 1926).

CASE 3. Multiple gastric ulcers, diffuse gastritis. Partial gastrectomy, appendectomy. Relief for one year only.

Mr. David S., age 38, referred by Dr. Wm. E. Robertson, fell from a box car November, 1923, striking the sternum. Soreness over lower sternum followed, succeeded by burning in the epigastrium and in February, 1924, by nervousness and inability to work. The tonsils and adenoids were removed in March, 1924. Gastric symptoms with much sour belching and pain beginning 1 hour after meals, and radiating from the epigastrium to the back, increased; and the patient finally could eat only ice cream with comfort, and

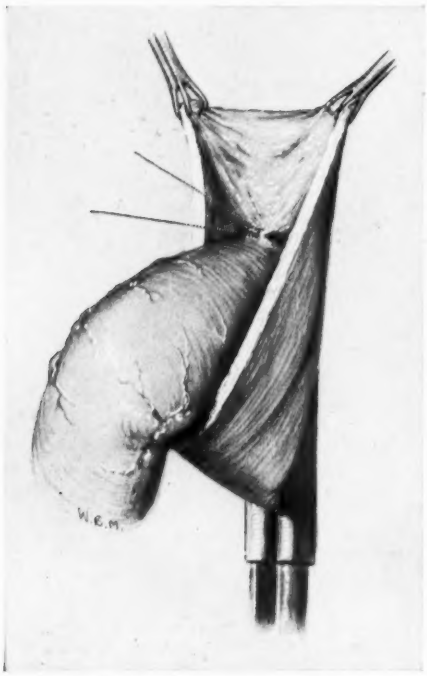


Fig. 13. Union of duodenum and gastric mucous membrane completed.

lost 21 pounds. The abdomen was scaphoid without tenderness or rigidity. The X-ray report was "ulcer of lesser curve near the pylorus."

Operation, June 20, 1924. Spinal anæsthesia by six centigrams of alcoholized stovaine in the twelfth dorsal interspace, with local anæsthesia by 1 per cent procaine to finish the operation. An upper right rectus incision was used. The stomach contained a number of ulcers, one 2 by 1.5 centimeters, with step-like penetration into muscularis on the lesser curve midway to cardia; a second ulcer partially healed, measuring 3 by 1.5 centimeters, near the middle of the greater curvature, while several small ulcers with dirty greenish bases were found on the anterior wall near the greater curvature. The mucosa was very adherent to the muscularis and the removal of the mucous cuff by dissection was difficult. In this adherent type, it was later found that a large curette was very effective to rapidly remove the mucosa. A short cuff was formed, the stomach being resected proximal to the ulcers, the upper border of the duodenum split to enlarge its opening, and a telescopic union made with three rows of No. 0 and No. 00 chromic catgut. The appendix was removed. There was primary union and the patient was discharged on the thirteenth day after operation. Complete relief from gastric symptoms followed the operation until June, 1925, when the patient developed slight discomfort following food that has raised the question of residual or recurrent ulceration. The symptoms increased in intensity and January, 1926, the patient was asked to return for study and possible reoperation.

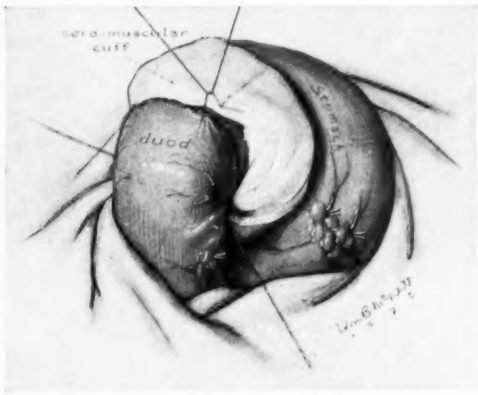


Fig. 14. Clamp removed to determine oozing or leakage along suture line. Anterior row of interrupted intermediate sutures uniting outer surface of duodenum and denuded muscular coat of stomach being introduced.

CASE 4. Recurrent hæmorrhage from duodenal ulcer. Telescopic partial gastrectomy and appendectomy. Recovery.

Mr. Charles A., age 25, electrician, referred by Drs. Rosen and Oliensis. Eleven years ago the patient had hæmatemesis with epigastric pain. This recurred 8 years ago and bloody stools were noticed 4 months ago. Last month he vomited 8 ounces of clotted blood. The appetite has always been good without distress from food. The skin is pale and icteroid, with moderate anasarca and puffiness of the face. There is some pyorrhæa and gingivitis. The pulse is 110, and there is a mitral systolic murmur. The urine shows a trace of albumin and a few fine granular casts and cylindroids; leucocytes, 8200. Polymorphonuclears, 59; small lymphocytes, 39; large lymphocytes, 1; transitionals, 1; hæmoglobin 60–69; reds, 3,890,000. Blood creatinin, 1.5; blood chlorides, 62 milligrams. A blood transfusion of 360 cubic centimeters was given September 9, 1924. The X-ray report is "large 6-hour residue with deformity of the duodenal cap."

Operation, October 29, 1924, under spinal anæsthesia with stovaine. Six drachms of ether were also used. A 14-centimeter upper right rectus incision revealed an ulcer of the posterior wall of the duodenum 4 centimeters from the pylorus with a crater measuring 2 by 1 centimeters. The lower third of the stomach and first portion of the duodenum were excised, and a telescopic anastomosis made with two or three rows of fine chromic catgut sutures. Primary union occurred and the patient was discharged 3 weeks after the operation. No recurrence of symptoms had followed up to June, 1925.

CASE 5. Duodenal ulcer, recurrent after excision, cholecystoduodenostomy and Finney pyloroplasty. Partial gastrectomy with telescopic union. Recovery.

Richard D., age 25, printer, has had gastric symptoms since 1914. In 1922, a duodenal ulcer with subacute perforation into the wall of the gall bladder, of 2 weeks' duration, was excised with Finney pyloroplasty and cholecystoduodenostomy. This operation was followed by a severe intragastric hæmorrhage, and later a saphenous phlebitis. A few months after this operation, the gastric symptoms recurred with marked gnawing sensation in the epigastrium, 2 hours after meals. Later, the pain became continuous,

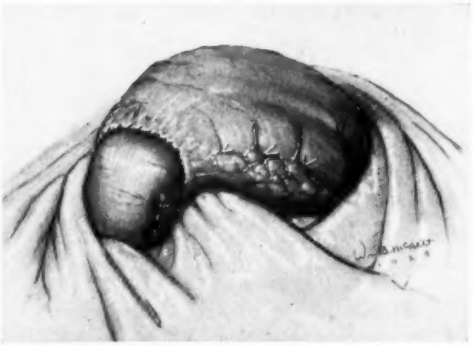


Fig. 15. Completion of sutures uniting outer layer of stomach to duodenum.

being increased by food and without vomiting. The X-ray showed a large 6-hour gastric residue, and deformity of the duodenal cap. The patient is pale, rather emaciated, and has a coagulation time of 6.5 minutes. A blood transfusion was given October 29, 1924.

Operation. October 31, 1924. A vertical 14-centimeter upper right rectus incision was used. Spinal anæsthesia by 6 centigrams of alcoholized stovaine in the twelfth dorsal interspace, reinforced by local anæsthesia with procaine and one-third of a grain of morphine, and a very small quantity of ether, given to dull consciousness. The duration of the operation was 180 minutes. A recurrent duodenal ulcer with a crater 2 centimeters broad penetrating to the serosa was found in the posterior wall of the duodenum near the pylorus. The gall bladder was adherent at the site of previous cholecystogastrostomy, but the stoma had closed. Adhesions were separated and the upper part of the duodenum and the lower one-half of the stomach were excised and a telescopic union made with two rows of continuous interrupted sutures of No. 00 chromic catgut. An appendectomy was also done. The patient was discharged 19 days after operation, and has had complete relief from all gastric symptoms up to last report made in January, 1926.

CASE 6. Ulcerating carcinoma of the stomach. Gastrectomy. Recurrence.

Thomas F., miner, age 47, referred by Dr. W. P. Hall. Father and three brothers had pulmonary tuberculosis, and patient has had frequent rheumatic attacks. In October, 1923, he developed pain one-half to one hour after meals with weakness and loss of flesh, but without nausea or vomiting. This attack lasted 6 weeks, and recurred in May, 1924, since which time it has been continuous. He has lost 18 pounds in the past year. There is increased resistance in the epigastrium.

Operation. November 7, 1924. Spinal anæsthesia by stovaine and local anæsthesia with procaine reinforced by 1 ounce of ether and 1/6 grain of morphine and 1/100 grain of scopolamine. Through a 14-centimeter upper right rectus incision, an ulcerating carcinoma involving the anterior wall and greater curvature of the stomach near the pylorus was found. The ulcer base, dirty and sloughing, measured 2.5 by 4 centimeters, the ulcer edges were thick, indurated, and irregular, and nodules were found along the greater curve of the stomach, and enlarged lymph nodes along the greater and lesser curves.

Two-thirds of the stomach and the first part of duodenum were removed, with telescopic anastomosis by three rows

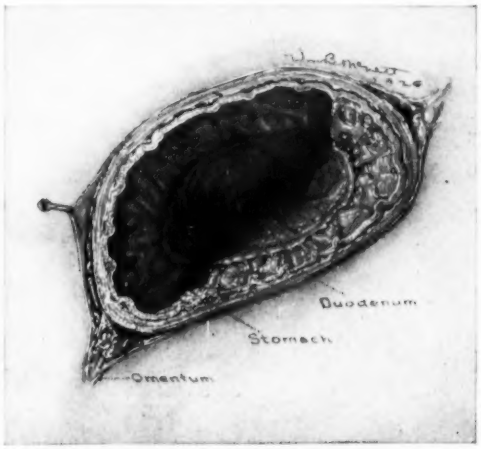


Fig. 16. Union viewed from within stomach after operation on cadaver. The large open, funnel-shaped stoma is shown.

of sutures. The patient was discharged 14 days after operation, and on January 19, 1925, he had continued free from symptoms and had gained 35 pounds. In September, 1925, the patient died from metastasis of the cancer.

CASE 7. Duodenal ulcer with partial pyloric obstruction. Partial telescopic gastrectomy and appendectomy. Recovery.

Mr. Joseph L., referred by Dr. Arthur McGinnis, age 47, toolmaker, had typhoid at 30 years, followed by dyspepsia with gaseous eructations, colic, and constipation. When 45 years old, he had a gastric attack, with pain under lower sternum, relieved by food. Four months later, the condition recurred, and since then attacks have recurred at decreasing intervals. The pain has been constant for the past 3 weeks, and is not relieved by food, although to some degree by soda. There has been no vomiting or passage of blood. Citrus fruits especially disagree. The patient has lived on liquids for 4 weeks and has lost 7 pounds. The gastric analysis shows much mucus and undigested food, and the duodenal cap does not fill under the fluoroscope.

Operation, January 22, 1925. A vertical upper right rectus incision was made. There was an ulcer on the anterior face of the duodenum just distal to the pylorus, with pyloric narrowing. Adhesions were separated, the upper duodenum and lower end of stomach freed, and lower third of stomach and first portion of duodenum excised. The cuff of gastric mucosa was readily separated and removed. Four centimeters of duodenum were telescoped into the stomach with an outer serous and inner mucous row of continuous fine chromic catgut, and an intermediate row of interrupted fine catgut sutures. The appendix had a thickened mucosa and contained fæcal masses, and was removed. The duration of the operation was 130 minutes. The initial blood pressure of 138–80 rose during the operation to 160–80. There was no wound complication, and except for an attack of nausea and vomiting on the eleventh day, the postoperative course was uneventful. At last report, January, 1926, the patient had remained free from gastric symptoms.

CASE 8. Marginal ulcer with hæmorrhage following gastrojejunostomy for duodenal ulcer. Anastomosis disconnected, ulcer excised, openings in stomach and jejunum

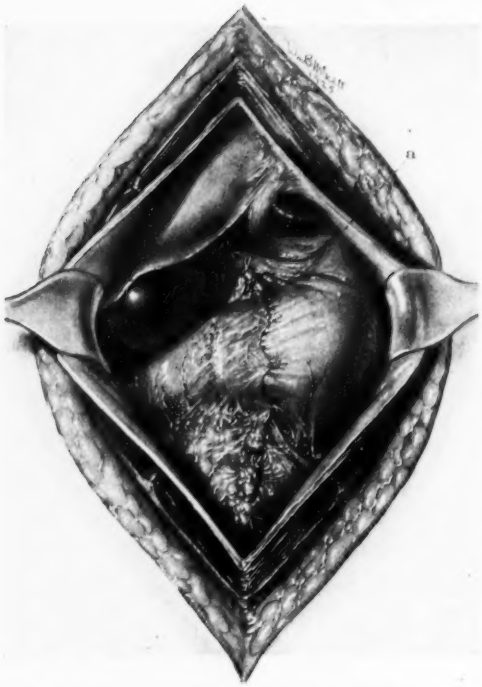


Fig. 17. Case 9 completed. The openings in the gastro-hepatic and gastrocolic omenta have been closed by fine ligatures relieving tension. The portion of peritoneum reflected from the duodenum has been brought back over the anastomosis and attached by several interrupted sutures to the anterior face of the stomach also relieving tension on suture lines.

closed. Telescopic partial gastrectomy, secondary hæmorrhage. Death.

Mr. John S., age 38, carpenter, referred by Dr. A. P. Butt. Gastric symptoms of several years' duration for which a posterior short loop gastro-enterostomy was performed in 1923. A few months after operation the distress a short time after eating recurred, and in November, 1924, the patient was almost exsanguinated by a violent hæmorrhage from the stomach. The patient shows a residual anæmia from this loss of blood.

Operation, January, 1925, in West Virginia. Spinal stovaine and local infiltration novocain anæsthesia was used. Marginal induration was found at gastro-enterostomy opening from secondary ulcer, a shallow ulcer about 15 millimeters in diameter was also found in the first portion of the duodenum. The stoma was of ample size. The jejunum was disconnected from the stomach, the marginal ulcer excised, the openings in the stomach and bowel closed, and the lower fourth of the stomach and first portion of the duodenum excised with a telescopic end-to-end anastomosis. Some oozing, the source of which was not easily determined, was noticed that was apparently controlled by a small sponge introduced deep into the abdomen above the anastomosis. The pad was replaced by a cigarette drain and the abdomen closed. Duration of operation about 160 minutes.

Following the operation the pulse soon rose from 90 to 124, the patient vomited a small quantity of blood and believing there was oozing into the stomach, I counseled delay. A small blood transfusion was given but the symptoms increased, and 8 hours after operation, the patient being *in extremis* Dr. Butt reopened, the patient dying before the source of the bleeding was located.

In this case I used poor judgment in attempting such an operation in a new environment and upon an anæmic patient. A two-stage operation would have been safer. The source of oozing should have been determined before the abdomen was closed. In a more recent case of oozing during the operation a puncture of the pancreaticoduodenal artery by the posterior row of sutures was found. The early postoperative shock should have been treated promptly by re-operation.

Case 9. Duodenal ulcer perforating into liver. Telescopic gastrectomy and appendectomy. Recovery.

Mr. Julius K., referred by Dr. John B. Roxby, age 47, salesman, has had attacks of indigestion for 25 years. Formerly these attacks occurred during the Spring and Fall, and lasted about 1 week with food ease and hunger pain. For a month the pain has been almost continuous without relation to the type of food, and without relief after eating. Periods of severe pain referred to the lower anterior chest, preventing work, recurred both day and night.

Operation, March 12, 1925. Spinal anæsthesia by alcoholized stovaine, 6 centigrams in the first lumbar interspace, reinforced by local anæsthesia with procaine-adrenalin was used. Operation revealed an ulcer of the upper anterior wall of the duodenum close to the pylorus that had invaded the inferior surface of the right lobe of the liver (Fig. 5). Telescopic gastrectomy was performed with three rows of No. 0 and No. 00 chromic catgut sutures, with removal of first portion of duodenum, one-fourth of stomach, and a small portion of adherent liver. The appendix was removed and the defect in the liver sutured. The duration of the operation was about 120 minutes. Pulse at the close 70. There was an uninterrupted recovery and the patient was discharged from the hospital on the fourteenth day. One and one-half months after operation the patient continued to have complete relief of symptoms and had gained 11 pounds. In excellent condition January, 1926.

Case 10. Duodenal ulcer with subacute perforation to the head of the pancreas. Telescopic gastrectomy. Postoperative thyrotoxic crisis. Recovery.

Mr. Peter T., referred by Dr. H. F. Tye, age 57, single, clerk. A tall lean man, had complained of burning in the epigastrium for 3 years with hunger pain and food ease. Food usually gave relief for 2 or 3 hours. He had a severe attack of indigestion at Christmas 1924, when he was unable to work for 4 days. He has never vomited but has lost 10 pounds in the past 2 years. There is a symptomless adenoma of the left lobe of the thyroid the size of a small plum. On X-ray examination, the stomach empties in 7 hours, the duodenal cap does not fill, and an ulcer of the first portion of the duodenum is diagnosed.

Operation, March 31, 1925, through an upper right rectus incision under stovaine-spinal and procaine-local anæsthesia, showed an ulcer of the posterior wall of the lower part of the first portion of the duodenum; adherent to the pancreas, the head of the pancreas forming the base of the

Fig. 18. Variation in technique with primary division of duodenum. Guides for the continuous seroserous suture being introduced.

ulcer. The upper duodenum was freed from the adhesions, and the lower fourth of the stomach and first part of the duodenum excised, and the duodenum telescoped for a distance of about 3 centimeters into the stomach with an outer and inner row of continuous fine chromic catgut, and an intermediate row of interrupted catgut sutures. The cuff of gastric mucosa was easily separated and excised. The wound was closed without drainage. The duration of the operation was 140 minutes. The blood pressure 150–82 before the operation, soon fell to 132–60, from the spinal

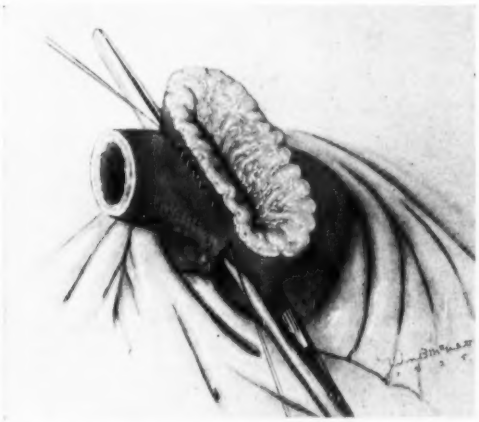


Fig. 19. Stomach divided after primary division of duodenum and seroserous suture preparatory to removal of cuff of mucosa. This variation in technique was used in a number of the cases; but it was found difficult to remove the cuff of mucosa without damage to the line of seroserous suture.

anæsthesia; and then progressively rose as about 200 mils of 1 per cent procaine with 18 drops of adrenalin were given by local injection. At the completion of the operation the blood pressure was 206–100. The pulse 112 at the completion of the operation, gradually increased in rate, and in 48 hours the patient was restless and semi-delirious; the temperature 103.2 degrees F., the pulse 140, and it was realized that he was in a thyrotoxic crisis. Under refrigeration, the symptoms rapidly cleared and the patient was discharged in April, 1925. There was no wound complication, and thus far (January, 1926) the patient has had complete relief from gastric symptoms. Recurrence of thyrotoxic symptoms followed by thyroidectomy in January, 1926.

KINEPLASTIC AMPUTATIONS; ARM–BIMOTOR AND A PROSTHESIS

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Professor, Faculty of Medicine; Member of the Faculty of the University and Chief Surgeon of Pinero Hospital

THE study of the kinematization of amputation stumps has a special interest for it arouses in the mind of all surgeons the natural desire to rehabilitate the maimed by supplying the lost limb. The ideal in the problem of the mutilated is to give to the artificial limb the power to function completely—the ideal in every operation being to provide for the complete substitution of any organ, be it kidney, artery, or joint.

As far as mutilations are concerned, the tendency in kineplastic methods is toward the new physiological surgery or functional surgery in which kinematized muscles move the prosthesis.[1] It is not claimed, therefore, that the limb should be replaced by a natural grafting process, as has been attempted in the case of joints, kidneys, etc., but that an artificial limb shall be fitted to a stump supplied with muscles which have been prepared to hold the prosthesis by perforations lined with skin. When the prosthesis is adjusted these muscles transmit movements at will.

[1] Vanghetti's method.

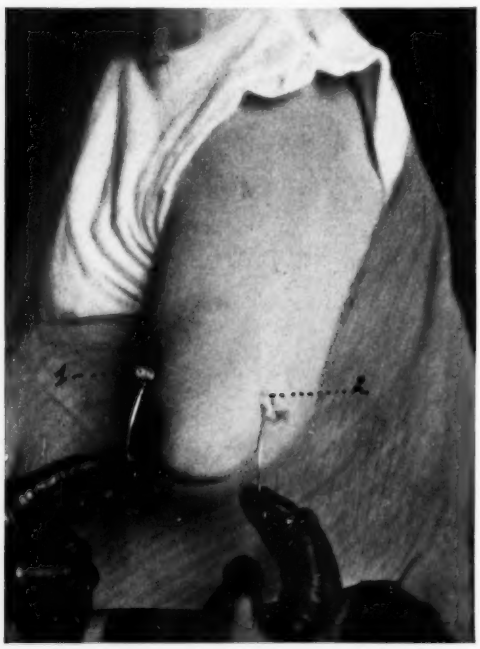

Fig. 1. Case 1. Double motor for forearm; 1, biceps motor; 2, triceps motor.

The grafting of a natural limb to replace a mutilated one is a problem foreign to kinematization of the limbs. This latter seeks the solution of a problem correlative with the present advance in surgery and the art of prosthetics. Kinematization is an original and very reasonable branch of surgery which is closely associated with orthopedics.

In an earlier publication (1) I presented reports of cases of patients maimed in the forearm for whom I had succeeded in obtaining excellent practical results. At that time I compared kineplastic amputations of the forearm with the radiocubital pincers of Krukenberg-Putti (4). In Surgery, Gynecology and Obstetrics, in 1923, I described a kinematic prosthesis which I believe is original with me and which provides a very satisfactory method of dealing with very short stumps of the forearm. I also described (2) a new process for the kineplastic disarticulation of the elbow, demonstrating the desirability and advantages of such disarticulations. In this article, I

Fig. 2. Case 2. Showing the bimotor, biceps and triceps.

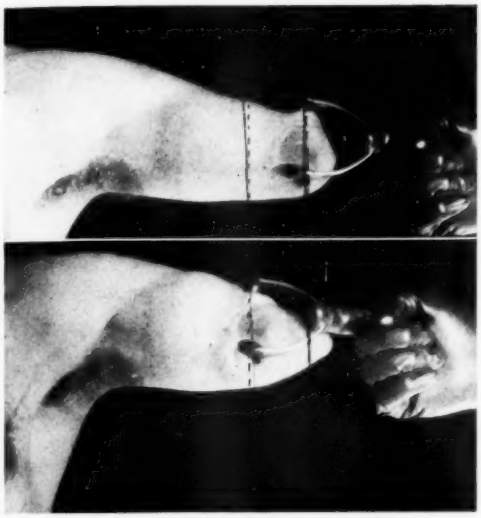

Fig. 3. Case 3. Biceps motor. During the "pose" the patient worked his motor.

present 3 cases in which patients maimed in the arm were later provided with prostheses for two-motor stumps (bimotor) which were made from the biceps and triceps. These patients are at present going about their usual businesses.

Hence kineplastic amputation of the upper limbs maintains the great interest the subject inspired from the beginning, and all my enthusiasm is at present directed toward securing by means of kineplastic motors, an artificial hand, lively and mobile, similar to the natural one.

A stump with two motors, a bimotor, answers the purpose best, as the muscular activities of both motors are controlled and exercised antagonistically; when one motor bends or contracts, the other lengthens or expands, as in the normal hand. This is shown in the 3 patients for whom arm stumps with two motors were provided; one motor is controlled by the biceps and the other by the triceps, the former motor situated on the front surface of the arm and the latter on the back surface, the first flexor, and the second exsensor, each antagonistic to the other in action but in permanent tension or mutual action when they are mounted on their corresponding prostheses (Figs. 1, 2, and 3).

A kineplastic stump with a single motor, a unimotor is consequently inferior in efficiency and result to a bimotor stump, since the antagonistic motor must be replaced by a spring, and the substitute is incomparably inferior in action to a

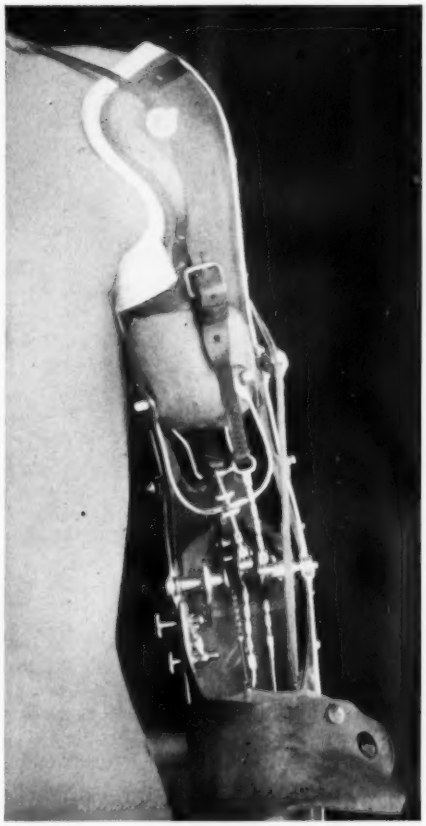

Fig. 4. Prosthesis Sauerbruch furnished to patient.

muscle with its varied and multiple manifestations of power, the latter being voluntary and active, while the former is purely and simply passive, mechanical, static, immutable, and permanent.

An amputation stump which can be provided with two motors, affords us, therefore, two forces of great potentiality. This is particularly true when amputation has been done in the lower two-thirds, as it places at the orthopedist's disposal the entire biceps and triceps muscles.

The technique which I use includes the making of a skin-bridge or Pellegrini. More satisfactory results are found when this operation is carried out on the upper arm than on the forearm, for the skin of the upper arm is looser and more elastic because the subcutaneous cellular tissue is yielding and supple. This facilitates the formation of

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 5. Another prosthesis furnished to patient.
Fig. 6. Bimotor with prosthesis; 1, for flexion of elbow; 2, for rotation of the hand.

Fig. 7. Flexion of elbow, rotation of the hand and flexion or extension of the finger.

ample, large, wide tunnels, an admirable condition in that it favors orthopedic results and the best adaptation of the apparatus to be inserted in the tunnel or eye of the motor. As I have stated in a previous article (3), the larger the skin tunnel, the better the adaptation of the motor to its prosthesis. Or, in other words, the power of the motor is better applied the greater the skin surface of the tunnel which is utilized in the transmission of its energy to the prosthesis. In any one of my 3 cases the finger could be inserted easily in the skin tunnel. With up-to-date technique the operation is simple and easy, and may be done by anyone familiar with the usual operative practice. Sauerbruch has adopted this method with little variation (5).

Anæsthesia may be local and infiltrative. For greater ease in the operation, I have used Kulenkampff's truncular anæsthesia which dissociates pain from muscular movement and makes it easier for the operator to choose the site of the tunnel through the muscle by taking it at its widest expansion or free action.

The skin is incised to form a bridge 5 centimeters long and 10 centimeters wide. The skin is freed with its surface aponeurosis and formed into a tunnel by means of a suture *en cartouche*. The muscle that is to be turned into a motor is sutured at its farther extremity near the end of the stump on the fibrous scar of the old amputation so that the muscle may be left as long as possible, and at the same time, that there may be no extra hæmorrhage when it is sectioned. The muscle is dissected and freed upward; the muscular mass is sectioned in two frontal flaps, one of which passes in front of the tunnel or skin bridge, and is sutured to the other muscular flap behind the tunnel which is thus closed and clasped by the muscle motor thus formed. Hæmostasis is secured and the edges of skin of the wound sutured directly. External dressing is applied. This operation is effected on both arm surfaces, forming one motor with the biceps and the other with the triceps. A week later the stitches are removed; a fortnight later, gentle mobilization is effected; and a month later, active exercises are instituted which are gradually intensified and are carefully controlled and regulated by a nurse or a responsible, skilful masseuse.

It is well to add that it is at this stage that the operation may fail, for the patient, wishing to gain time and to demonstrate his kinetic progress, indulges in too strenuous an effort and brings on ulceration of the internal wound in the skin-tunnel, or else the muscular suture of the motor becomes torn. Ulceration of the tunnel heals

slowly, and leaves a retractile nodular tissue which does not bear pressure as normal skin does; the latter develops calluses with exercise; the former produces cicatricial tissue which constantly becomes ulcerated.

The motive efficiency of kinematized arms is marvelous, re-education being easy and inspiring; easy, because the flexion or extension of the forearm on the opposite side recalls at once the contraction of the biceps and triceps now kinematized; and inspiring, because it gives the impression of a resurrection of dead muscles—muscles which have been condemned as hopeless by all surgeons who have written on the technique of maiming operations of the arms from Celsius down to our modern and contemporary surgeons. In carrying out these kineplastic operations on the arm, two very potent muscles are "vitalized" so that the orthopedist is provided with a biceps with power intact and a triceps no less potent.

The result of the operation is all that could possibly be desired, for the motors are perfect, faultless. Their motor power is entirely active, and the potency which you may permanently observe in these patients is the best proof I could offer you.

In one patient, the construction of the motors was done in two operations. At the first operation the biceps motor was constructed, 2 months later the triceps motor. In the two other patients, kinematization was effected in one operation.

The two-stage operation, at invervals of 1 or 2 months makes it possible to secure more skin for the tunnels, as the skin yields to the traction of the first operation. Kinematization is carried out with ease in a single session when the stump affords plenty of skin. The former process will ever afford greater guarantee of ultimate success.

The motors being prepared, they must be used for the active movements of the prosthesis, and thereafter, the study of the kineprosthesis of the arms must be begun. The subject is a vast one, and I shall endeavor to avoid analyzing it in a wearisome fashion in this brief article. Therefore, suffice it to state here that a good prosthesis should afford flexion and extension movements of the forearm (elbow joint) and, furthermore, flexion and extension movements of the fingers (finger joints), followed by supination and pronation of the forearm (hand), and flexion and extension of the wrist (carpus). These four movements are correlative and complementary, and their order of importance or categorical diminution would be: first, flexion of the fingers; second, flexion of the forarm on the arm; third, pronation of the hand; and fourth, flexion of the wrist (carpus.) It is well to note that with them are made practically the most useful movements of the principal articulations: elbow, fingers, wrist, and ulna.

Many and various models of prostheses have been constructed, but the one which at present enjoys the greatest favor is the one based on Sauerbruch's studies (5). The two kineplastic motors—biceps and triceps—are utilized in Sauerbruch's prosthesis for the daintiest and most delicate movements, the opening and closing of the artificial fingers; that is, the grasping of objects. Flexion of the forearm is performed by means of straps and a shoulder-piece attached to the shoulder; while pronation and supination of the hand are controlled and executed by means of the contraction of the trapezius muscle of the shoulder. Flexion or extension of the carpus is absent in Sauerbruch's prosthesis, but might well be effected by adding a simple mechanical appliance, and be produced by bending the spinal column toward the side.

Sauerbruch's arm may be adjusted to any position to facilitate prolonged or continuous effort by means of a system of closure with mechanical tops which the patient puts on at will; and thus he may freely hold an object between his fingers without tiring the motors, contracting the opposite shoulder or the trapezius muscle which controls the working of the prosthesis.

Therefore it is evident that even if Sauerbruch's prosthesis is not absolutely ideal, for it does not permit flexion of the carpus, nevertheless, it is a prosthesis which has great and practical advantages as the arm may be used freely for the necessary acts in the course of daily life, and for compensating satisfactorily for the loss of the entire upper limb.

Before concluding, I wish to state that three factors enter into the success of kineplastic amputations: (1) the surgical factor; (2) the orthopedic factor; (3) the factor of the individual, or the patient. The first, it may be unhesitatingly affirmed, is well under control because the technique now used by surgeons is thoroughly efficient. The second, at the hands of orthopedic engineers, has been solved relatively, but very satisfactory, as is shown by the Sauerbruch apparatuses. Lastly, the third factor is the one which is the key to complete success, depending as it does on the power of intellect, of the will of the patient, and on his ability to concentrate on his own re-education.

CONCLUSION

In conclusion I may say that my patients can grasp any object of average weight, lift it to the mouth or either side of the head; bend the arm or extend it; they can go through all the movements of pronation or supination of the hand necessary to hold objects or take articles and carry them to the mouth and raise the hand in complete abduction so as to form a right angle with the body (Fig. 7).

In every one of these attitudes the fingers can take hold of an object or lay it down at will through the kineplastic arm motors. In a word, we have an artificial upper limb, the success of which depends entirely on the personal effort of the patient in training and re-educating himself in its use.

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SUBASTRAGALOID ARTHRODESIS IN THE TREATMENT OF OLD FRACTURES OF THE CALCANEUS

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ALTHOUGH total disability very commonly follows fracture of the calcaneus, the treatment of this condition has been on the whole unsatisfactory, and a rather careful search of available literature does not offer much assistance in the solution of this problem.

Cotton considers this disability due to an outward broadening of the calcaneus resulting from a lateral impaction of the peroneal plate and to growth of new bone behind it. He states that the external malleolus impinges upon the exuberant bone and causes pain by pinching the peroneal tendons when in motion. Lateral motion is limited and painful. The limitation is due either to the blocking of the posterior subastragaloid joint and to the fracture across it, the fracture displacing the unbroken joint surface or shortening the slide, or to new bone heaped up anterior to the malleolus. He suggests as treatment, removal of all spurs on the calcaneus and in more severe cases liberal excision of the impacted portion of the calcaneus beneath the external malleolus. This is followed by forcible manipulation—rotation, abduction, and adduction, to remove all obstacles to normal motion. For cases of shortened and flattened heel with outward displacement, he suggests cross sectioning the calcaneus behind the posterior portion of the subastragaloid joint, and molding of the heel in a plaster-of-Paris-bandage.

Magnuson also, considers the disability to be due to impingement of the peroneal tendons against the external malleolus and in addition, to pronation of the foot and strain on the plantar fascia, with loss of lateral motion. Treatment recommended by him is similar to that suggested by Cotton.

In the cases of disability following fractures of the calcaneus observed by the writer, the findings do not substantiate those of Cotton or Magnuson, in spite of the fact that these cases showed severe impaction and lateral displacement of the calcaneus in the region of the external malleolus with limitation of motion in the subastragaloid joint. This is the only type of fracture of the calcaneus which results in serious disability.

When one considers the anatomy and function of the ankle joint he finds the astragalus articulates with the tibia and fibula forming the tibio-astragaloid joint, in which dorsal and plantar flexion of the ankle joint take place. Lateral motion in the tibio-astragaloid joint is almost completely limited by the position of the external and internal malleoli on each side of the astragalus. Below is found the subastragaloid joint which is formed by the astragalus and calcaneus, the function of which is to provide pronation and supination of the foot joint. The inferior extremity of the internal malleolus is slightly higher

than the subastragaloid joint, whereas the tip of the external malleolus is slightly lower than the outer portion of that joint. Eversion and inversion of the ankle joint are performed in the mediotarsal joint, which is composed of the articulations of the astragalus and the scaphoid on the medial side, and the calcaneus and the cuboid on the lateral side.

The cases seen by the writer have had but little limitation of motion and very slight pain on dorsal and plantar flexion, except when the latter movement is carried to the extreme. Pain was then referred to the posterior portion of the subastragaloid joint. Lateral motion in the subastragaloid joint ranged from complete limitation in pronation and supination to approximately 25 per cent range of motion accompanied by severe pain on weight bearing. In fact these patients complained of as much limitation of motion in active and passive supination of the subastragaloid joint as in pronation. In other words, in spite of the fact that there was an outward impaction of the fractured calcaneus there was but little limitation in dorsal and plantar flexion, and supination was as painful and limited as pronation. A careful study of the roentgenograms in these cases reveals almost without exception, fracture of the calcaneus into the subastragaloid joint, and in addition often fracture of the inferior portion of the astragalus with it.

In rare cases there is also a fracture into the calcaneocuboid joint, which obviously causes limitation in inversion and eversion of the tarsus and pain. Not infrequently the impaction extends posteriorly into the plantar surface of the calcaneus, resulting in the formation of exostoses, which are obviously very painful on bearing weight.

The author's deduction is, therefore, that the disability in these cases is not due as a rule to any impingement of the external malleolus and the peroneal tendons against the impacted portion of the calcaneus, but is due almost invariably to a traumatic osteo-arthritis in the subastragaloid joint. The presence of spurs contributes to the disability.

The usual history given by patients afflicted with this condition is that they are able to get about with comparatively little disability when they walk on a perfectly smooth surface, but when they walk on uneven surfaces they suffer severe pain in the ankle joint, and fully as much in supination as in pronation.

As an illustration, one of the writer's patients suffered a severely comminuted fracture of both calcanei, extending into the subastragaloid joints, with the lateral impaction of the calcanei as described by Cotton and Magnuson. This patient had the usual severe disability in both ankles on weight bearing. He was fairly comfortable when walking on a smooth surface, but suffered severe pain when walking on uneven ground. The roentgenograms showed that the left heel was more comminuted than the right. In due time there was almost complete limitation of motion in the subastragaloid joint of the left ankle. Coincidentally the pain and disability were almost completely overcome in the left ankle, whereas the pain in the right ankle persisted. Accidentally he tripped on a rough surface, broke up the fibrous adhesions that had formed in the subastragaloid joint, and the pain in the left ankle returned.

In view of these findings therefore, the treatment obviously should be directed to immobilizing completely the subastragaloid joint, and thereby arresting the traumatic osteo-arthritis present, instead of breaking up these adhesions, as recommended by Cotton and Magnuson.

In order to accomplish this immobilization, arthrodesis is the procedure to be recommended. By this means one can limit pronation and supination of the foot. This operation was recommended by Davis and Ryerson and others for the relief of extreme paralytic valgus and varus deformities of the ankle.

The technique of this procedure is as follows: after a well fitting tourniquet has been applied to the limb, a horizontal incision is made along the medial surface of the ankle joint, beginning immediately posterior to the internal malleolus and extending around the tip anteriorly and slightly upward to the scaphoid bone. Care must be taken not to injure the tendon of the tibialis posticus muscle. Dissection is carried on through the soft tissues and the subastragaloid joint is exposed. By the aid of a chisel the cartilage of the posterior articulation of the calcaneus and the astragalus is carefully removed. In order that a complete arthrodesis be obtained, another incision is made on the outer side of the ankle joint extending from a point immediately posterior to the tip of the external malleolus, then under the tip and slightly upward to a point immediately superior to the cuboid bone at its articulation with the calcaneus. As on the inner side, the dissection is carried on through to the periosteum care being taken not to injure the peroneal tendons. The subastragaloid joint will be found slightly superior to the tip of the external malleolus and the remainder of the cartilaginous surfaces of the joint is removed. After the usual closure the

ankle is immobilized in a plaster-of-Paris cast extending from the toes to a point just below the knees, maintaining a neutral position of the foot. If the fracture has extended anteriorly into the calcaneocuboid joint, the outer incision is carried farther forward exposing this joint, and the cartilaginous surfaces are removed. If the comminution has extended posteriorly and has resulted in exostoses on the inferior portion of the calcaneus, they obviously should be removed.

The plaster cast remains for 3 months, after which the patient is permitted to bear weight in a shoe with a well fitting longitudinal arch support. In addition the patient receives a systematic course of physiotherapy treatment in order to restore the dorsal and plantar flexion of the ankle joint.

The subastragaloid arthrodesis has been performed in four cases which presented the findings as previously described. The first case was operated upon in April, 1924—the last in May, 1925. Sufficient time has not elapsed for final judgment to be passed on this procedure. However, the writer has had such gratifying results that he does not hesitate to recommend this form of treatment for the alleviation of this serious disability.

Although it is not within the scope of this paper to consider the treatment of recent fractures, nevertheless the writer strongly urges the employment of the subastragaloid arthrodesis in those impacted fractures of the calcaneus in which the roentgenogram shows involvement of the subastragaloid joint. This should be done in addition to the treatment for recent fractures as prescribed by Cotton and Funsten. It is more than probable that such a procedure would have to be carried out at some future time, whereas if it were done shortly after the occurrence of the fracture it would result in a great economical saving, particularly in industrial patients.

CONCLUSION

Disabilities resulting from impacted fractures of the calcaneus are due almost invariably to a comminution, extending into the subastragaloid joint, which results in a traumatic osteo-arthritis. Consequently, there is severe pain on pronation and supination of the foot. The invasion of the fracture into the calcaneocuboid joint and into the plantar surface of the calcaneus causes exostoses which contribute to the disability. The treatment therefore consists in arthrodesis of the subastragaloid joint. If the calcaneocuboid joint is involved, this also should be arthrodesed. If spurs are present on the plantar surface they should be removed. Subastragaloid arthrodesis has been performed on four cases and the results have been so satisfactory that the writer urges this treatment for this type of case.

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AN OPERATION FOR INCONTINENCE OF URINE FOLLOWING PERINEAL PROSTATECTOMY

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PERINEAL operations, usually prostatectomy, that result in incontinence of urine leave a field for operative repair in which the surgeon has very little musculature to work upon. Dr. Young has reported relief of incontinence by suture of the internal sphincter from within the bladder, yet one cannot but feel that this operation would very frequently fail and would perhaps, if it succeeded, entail an unwelcome return of the retention of urine.

The operation to be described is offered as one that can always be performed without grave danger to the patient and without the least risk of bringing back obstruction at the bladder neck.

The operation was performed upon a man 70 years of age, who, following perineal prostatectomy a year previously, had suffered from constant complete loss of control of urination, day and night, ever since. (A history of chancre in youth and mercurial treatment at that time led to the suspicion of cerebrospinal lues, but normal reflexes and a negative blood Wassermann sufficiently ruled this out.)

The region of the prostate as felt by rectum was occupied by a hard, nodular mass all across the pelvis, and seemingly part of the perineal scar. Because of the hardness of this, carcinoma was at first suspected. X-ray examination was negative.

The urine showed a few pus cells; a few hyaline casts; a good concentration (1,020). Phenolsulphonephthalein output was 20 per cent in the first hour; 20 per cent in the second. The systolic blood pressure was 128.

The patient's general condition was neurasthenic. He had sought vainly for relief at various hospitals and declared himself ready to commit suicide if he could not be helped. He had lost 40 pounds in weight.

The operation was performed on October 16, 1923. Through the usual V shaped incision, the perineum was opened in the line of the old scar and the rectum separated from the urethra. Inadvertently the membranous urethra was opened, so in order to insure a dry wound counter drainage was made suprapubically. Returning to the perineum, the hole in the membranous urethra was closed with plain catgut. Some little dissection was done in the hope of finding some fibers of the external urethral sphincter, but the membranous urethra seemed to be completely surrounded by scar and no muscle fibers were found. Indeed, the only muscles in sight were the cut and scarred posterior end of the bulbocavernosus; the edge of the intact levator ani on each side; and the rectum behind. Lacking any other method of bringing pressure upon the urethra, it was decided to attempt to bring muscular pressure upon this by suturing together the two levators with the posterior part of the bulbocavernosus. This was very easily done after the bulbocavernosus had been freed from scar. The three muscles were brought together by three interrupted sutures of chromic gut. They made a muscular bed, the bulbocavernosus holding the two levators forward snugly under the membranous urethra, upon which the natural tension of the levators gave an upward tug.

The patient was in the hospital 2 days less than 3 months, during which time he gradually gained weight (from 127 to 147 pounds) and courage. His suprapubic opening was permitted to heal 3 weeks after operation, and for a week thereafter he had little control of his urethral muscles. Then he began to be dry at times, and on November 25 (about 7 weeks after operation), he was for the first time dry all night, but had passed his urine two or three times during the night. When he left the hospital on January 14, 1924, he was dry at night but was unable to control his urine by day except while sitting down. As soon as he walked about, he complained of marked urgency and desire to urinate which, if not heeded, would result in incontinence.

This condition gradually improved until October, 1924, 11 months after operation, when he reported that he was perfectly well; still arose twice at night to urinate, but could hold the urine half the day; had regained 30 of the 40 pounds which he had lost before operation, and had no leakage excepting a few drops when he sneezed.

A month later he was shown at the New York Academy of Medicine, and now in June, 1925, he does not arise at night; he does not leak under any circumstances; he has not leaked a drop in several months.

This operation was performed on the theory that the difference between complete incontinence and complete dryness is not the difference between a wide open faucet and a tightly closed faucet, but rather the difference between a faucet that drips very slightly and a tightly closed faucet. Consequently, one may expect, occasionally at least, to close such a dripping urethra by relatively slight or indirect muscular pressure. The use of a sling, made by junction of the edges of the levators to the bulbocavernosus, is suggested as a means of providing such support of a firm and stable character, and by means of an operation which seems relatively safe both in its immediate and in its ultimate consequences.

TECHNIQUE FOR THE ROENTGEN DIAGNOSIS OF FRACTURES OF THE CLAVICLE

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WHEN one follows the method ordinarily employed in the roentgen diagnosis of fracture of the clavicle, which consists either in making one roentgenogram in the frontal direction, centering the rays over the midpoint of the clavicle, or in exposing two films according to the stereoscopic technique, there are several important errors which may be committed.

In order to bear out this statement, let us review three cases, selected at random, in which we have been able to make a comparison of the X-ray data with our operative findings.

In the first case (Fig. 1) stereoroentgenograms were made, which in the stereoscope seem to show that superimposed upon the overriding fragments (*a* and *b*) there are two little shadows (*c* and *d*) which were interpreted as two small splinters. The roentgen diagnosis was: "Fracture of the clavicle, with two principal fragments, and two insignificant comminuted fragments." When we operated on this patient, we found the bone broken into five pieces, three of which we had not suspected, either as to their size or their disposition (one of them 3 centimeters long by 1.2 centimeters wide we are preserving). We find ourselves very much dissatisfied with this diagnostic result.

The second case (Fig. 2) which we examined, having fresh in mind the experience gained in the preceding case, was quite similar. The single roentgenogram showed nothing more wrong than the wedge-shaped overriding ends of the two fragments (*a* and *b*) of the broken clavicle. At operation on this patient we again found the bone broken into five large fragments and three small ones. This was another roentgenographic error.

In the third case (Fig. 3) the film seemed to show a fracture of the clavicle without displacement—a green-stick fracture. This impression proved even more inexact, for simple inspection of the clavicular region and palpation of the parts showed frank overriding of the fragments. At open operation, when we raised the flap we habitually employ in these cases, we could see that the superposition of the fragments was very marked, as is shown in the accompanying photograph of the operative field (Fig. 4). Once again we realized into how great an error we might be led by the classical roentgenographic technique.

How, then, in a case of clavicular fracture, were we to determine exactly the number of the fragments, the direction of the line of fracture, the degree of overriding, the distribution of the comminuted bone, etc.? In dealing with fractures of other long bones (humerus or tibia, for example) the details are perfectly well shown by films made at right angles; for a phase not suspected in the anteroposterior film may be demonstrated easily in the lateral position, or vice versa. If we desired to apply this principle to the study of the clavicle, we would have to make one anteroposterior film

Fig. 1. Superimposed upon the overriding fragments (*a* and *b*) there are two little shadows which were interpreted as two splinters.

Fig. 2. Roentgenogram showing wedge-shaped overriding ends of the two fragments (*a* and *b*) of the broken clavicle.

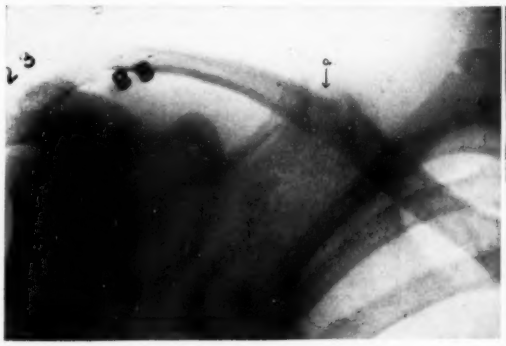


Fig. 3. Green-stick fracture (Case 3).

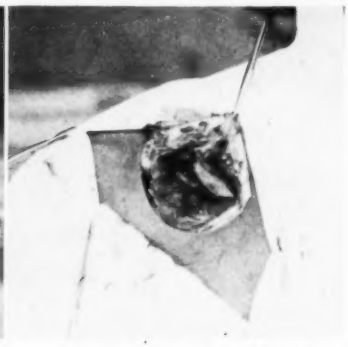


Fig. 4. Photograph of operative field (Case 3).

according to the classical technique, and (in view of the impossibility of making one in the lateral position) another vertical film, shifting the focus of the tube above the shoulder and the film downward; but this is difficult to accomplish. It occurred to us then to take advantage of the use of oblique projection of the rays and by taking pains to make the two roentgenograms with rays projected at right angles, to find the equivalent of the two right-angled planes of observation used with bones of the extremities, the trunk and the head.

This we have succeeded in doing with great precision by means of an instrument (Fig. 5) which consists of a quadrant of 90 degrees (*a*), with a perpendicular arm mounted at either end; one (*b*) sliding in a tunneled support (*c*), which is further armed with a concave beak (*d*) to fit the contour of the clavicle; the other arm (*e*) also sliding in a somewhat shorter tunneled support which can be moved the entire length of the quadrant and whose length is sufficiently reduced to permit it to be slipped along the quadrant over the shoulder, however broad may be the opening (*f*) which it leaves.

The simple arrangement which we have devised is clearly shown in the accompanying sketch (Fig. 6): the subject (*a*) to be examined is laid face down upon the table, a film (*b-b*) is placed under the clavicular region (*c*), and the tube placed in the position *A*, the rays centered parallel to the axis of arm *b* (Fig. 5) of the apparatus, and we make the first roentgenogram from above down, that is, from the head (*d*) obliquely downward toward the trunk (*e*). Then we change the film (or we may employ a large one, dividing it into two parts, covering the half not in use with lead) and center the rays from point *B*, following the axis of arm *e* (Fig. 5) of the apparatus, and we expose the second roentgenogram, from below upward, that is to say, from the trunk (*e*) obliquely toward the head (*d*). In making the first roentgenogram, it is important to push the film a

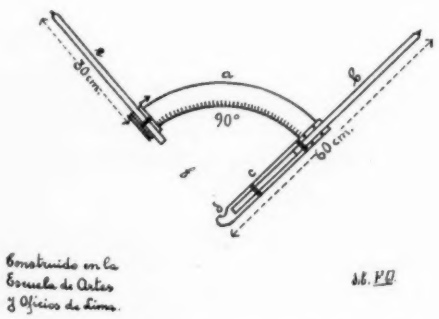


Fig. 5. Adjusting instrument. *a*, Quadrant; *b*, perpendicular arm; *c*, tunneled support; *d*, concave beak; *e*, perpendicular arm; *f*, opening.

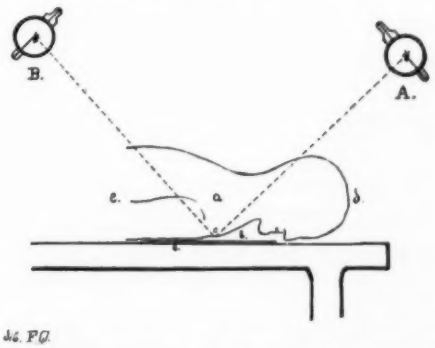


Fig. 6. Sketch showing the patient on the operating table and the position of the instrument when it is in use.

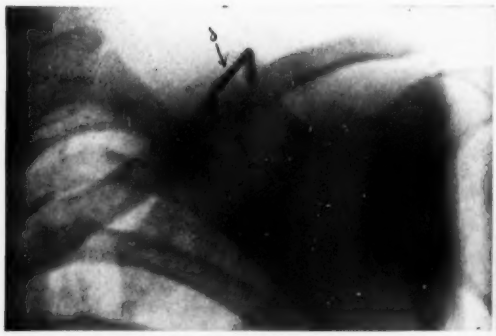


Fig. 7. Film secured by old-fashioned method.

Fig. 8. Film secured by new method.

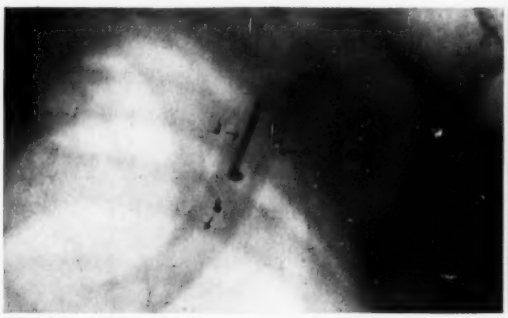


Fig. 9. Roentgenogram, from below upward.

Fig. 10. Uninjured shoulder, from above down.

Fig. 11. Uninjured shoulder, from below upward.

Fig. 12. Roentgenogram made by old method.

little bit toward the thorax, and in the contrary direction in making the second one.

In the first case in which we tried this technique we worked with my friend, the roentgenologist, Dr. Eladio Lanatta, the ninth of October, 1924. We selected a patient who carried in his right clavicle a Dujarier clamp which served admirably as a means of checking whether we had really succeeded in getting the two positions properly at right angles. It was also necessary to compare the results with those obtained by the ordinary technique. A preliminary roentgenographic study by the usual old-fashioned method gave us a film (Fig. 7) showing what seemed to be a satisfactory

Fig. 13. Stereoroentgenogram of case shown in Figure 12.

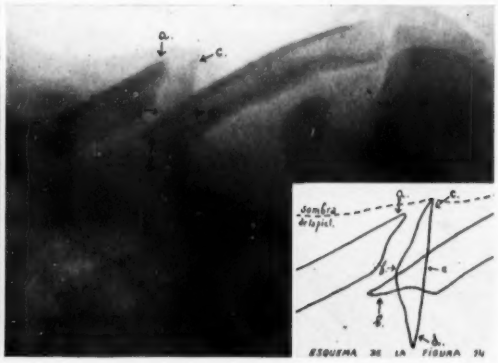


Fig. 14. Same case as that in Figure 12 with exposure by new method from above downward.

approximation (*a*) with slight separation of the fragments (*b* and *c*) and the clamp (*d*) in an oblique projection. The roentgenograms obtained by our new technique gave very interesting pictures: in one of them (Fig. 8) taken from above down (tube position *A*, Fig. 6) we see the clamp (*d*) in profile in all its details (bony union being conspicuous by its absence), anchored by one of its points to the internal fragment (*c*) and absolutely detached from the external fragment (*b*), the two halves of the clavicle widely overriding; in the other (Fig. 9) taken from below upward (tube position *B*, Fig. 6), we find the clamp in a position at a perfect right angle to that shown in Figure 8, recognizable only by one of the sides (its back) as forming part of an ideal bony approximation (*a*), giving no cause to suspect the marked overriding which we know exists. This latter film also shows the true curve of the normal clavicle.

One may, then, as we demonstrated before the Peruvian Surgical Society at its session of October 15, 1924, make roentgenograms of the clavicle in two positions at right angles, as is done with other long bones, which permit better study of the pathological roentgen anatomy of its fractures or other lesions, and make a proper postoperative check-up of the results. We have also demonstrated that the images produced are not distortions of the clavicular shadows: this is proved by the accuracy of the shadow of the clamp in Figures 8 and 9, and, what is more important, by the normal shadows of the clavicle on the uninjured side (Figs. 10 and 11) which show the characteristics of the clavicle as we are accustomed to see it in the classical anatomy of this bone; in the roentgenogram made from above down (Fig. 10) the clavicle appears with its lineal borders (*a*) as a straight line, such as this bone presents when seen in profile in osteology; but with the film made from below upward (Fig. 11) we find the normal S curve which we should see when we observe the bone from either of its faces. We have recently operated on this patient to extract the disturbing metallic clamp, which had become displaced and useless, and we were able to verify the accuracy of our roentgenological conclusions.

The following case was selected by us to test the exactitude of a pre-operative diagnosis made by our procedure because, an open operation being indicated, we would be able to realize *de visu* the operative anatomical and pathological demonstration. Naturally, for comparison, we made in advance an anteroposterior roentgenogram by the commonly accepted technique as well as a pair of stereoscopic films. The roentgenogram by the classical technique (Fig. 12) showed us an internal fragment (*a*) with beveled end and an external fragment (*b*) with a forked end—nothing

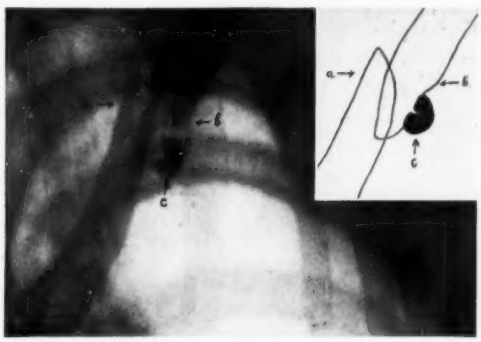


Fig. 15. Same case, by new method, from below upward.

more. The stereoroentgenograms showed us (Fig. 13) the same fragments (*a* and *b*) and surprised us by showing that the external branch (*c*) of the fork was split off.

None of these roentgenological data explained the outstanding clinical fact which in this case necessitated operation: one could feel a very sharp bony fragment which threatened to perforate the skin in this region.

The two roentgenograms made at right angles by our technique gave us a more complete and logical result: in the first film exposed from above downward (tube position *A*, Fig. 6) we found (Fig. 14) a beveled internal fragment (*a*) markedly overriding the external fragment (*b*) which was also beveled, but, in addition, a third loose fragment (*c-d*), long, placed vertically, with its outer border (*e*) straight and its inner border (*f*) convex, with very sharp-pointed ends (*c* and *d*), the upper point threatening to pierce the skin. The loose fragment was about 5 centimeters long by 1 centimeter wide. In the film exposed from below upward (tube position *B* of Fig. 6) we found (Fig. 15) the same fragments (*a* and *b*) overriding in the anteroposterior direction with their beveled ends somewhat obtuse, and superimposed upon them a very dense shadow (*c*) which was no other than that of the third fragment seen in its short diameter, thus permitting us to appreciate its thickness and its location anterior to the principal seat of fracture. We were now able to make a complete roentgen diagnosis—one agreeing with the clinical observations. At operation, when we lifted the flap of soft parts, there was presented to our vision and to that of visiting surgeons (among them the Dean of the Faculty of Medicine, Dr. Guillermo Gastañeta) a panorama of the zone of fracture exactly corresponding to the roentgenographic image of Figure 14: the two beveled fragments and the third fragment placed in front, directed vertically toward the skin and of the dimensions which we had calculated from the roentgenogram.

We have other cases in our series. At all events, as was expressed by the surgeon and radiologist, Dr. James T. Case, on the occasion of his visit to Lima, this original method which we present has undoubted advantages over the classical technique, and presents the very great advantage over stereoscopy that one may have the films in the operating room in sight of the surgeon, for his direct use during operation.

ANASTOMOSIS OF VEINS

A Method Without the Use of Special Instruments

By CLARENCE E. BIRD, M.D., New Haven, Connecticut
From the Department of Surgery, Yale University, School of Medicine

THE method described for anastomosing veins was developed to provide a large reversed Eck fistula in dogs, a stage in the procedure for the removal of the liver for experimental purposes, as outlined by Mann (5). It may, however, prove of use in human surgery.

A large opening, the caliber of the portal vein or larger, is essential for consistent success with the reversed Eck fistula. On first attempting the operation we used the method described by Bernheim, Homans, and Voegtlin (1) which involved blind cutting with scissors. This method is satisfactory only for small fistulæ, and all our animals died within 18 hours.

Similar procedures, such as using a cutting thread (3) or a fine cautery wire (6) instead of scissors, were not attempted. The operation of Jeger (4), in which he uses special clamps to isolate a portion of each vein wall without interrupting the blood stream, appears to have much merit. It has, however, the disadvantage of requiring special instruments and it cannot be used on small veins. An operation was, therefore, devised by which, with no special instrumentation, a large opening could be consistently obtained.

OPERATION

A healthy animal is kept without food for 12 to 24 hours, it being desirable to have the stomach empty and the portal vein unengorged. An incision is made in the midline from the xiphoid process 15 centimeters toward the pubis in a dog of average size. In males the penis is undercut, it being inadvisable to leave the midline because many large veins important in establishing compensatory venous return after operation would be cut. Two moist walling off towels are now introduced deep into the abdomen. A self-retaining

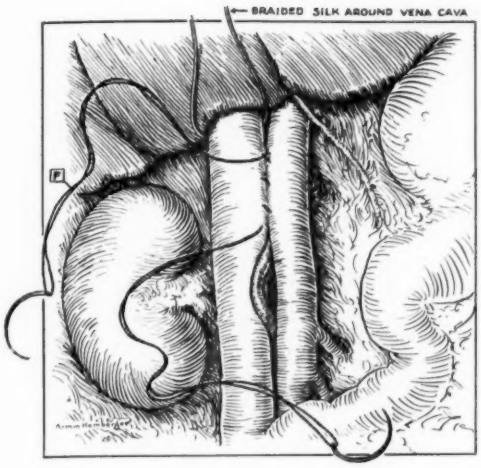


Fig. 1.

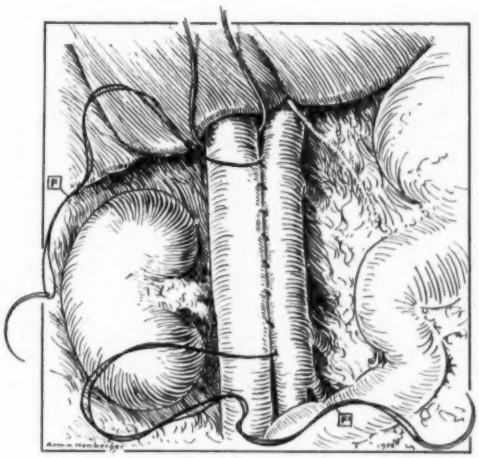


Fig. 2.

retractor is placed in position, and the operator's hand is placed on the vena cava side, with the assistant's on the portal side in such a way as to provide the exposure shown in Figure 1.

The method devised is similar to some types of lateral intestinal anastomosis. Further steps in the operation are described by illustrations and legends (Figs. 1 to 7).

The operative field (Fig. 1) is exposed by retraction of the liver, stomach, and duodenum, and by division of the right hepatorenal ligament. By blunt dissection the portal vein is stripped of fascia, fat, and lymphatics, so that the tributaries are seen. A heavy braided-silk ligature is threaded around the vena cava next to the liver reflexion. It is not tied until the anastomosis is completed. The assistant rotates the portal vein to the left, and a posterior row of doubled C silk on a No. 5 French needle is placed. It is important to stitch as far posteriorly on both veins as possible. The hepatic artery is buried progressively as indicated.

The posterior row of sutures is complete (Fig. 2). It is from 2.5 to 4.0 centimeters in length depending on the size of the dog. Stitches to be used for the anterior row, *F* and *F'*, are tied into the knots at the ends of the posterior row.

The hæmostatic stitch, *E* (Fig. 3), is accurately placed beginning where the knot in the doubled thread is shown. The first and last stitches, *A*, effectively close over the ends of the tuck raised in the portal vein. The vena cava is thick walled and needs only the closer placing to effect this purpose on its side. The spaces, *B*, should be smaller than the portions covered by thread, ensuring hæmostasis. The space, *C*, in the portal vein should be as long as the space, *D*, in the vena cava. Otherwise there may be difficulty in cutting the top from the tuck in the thin walled portal vein.

The hæmostatic suture, *E* (Fig. 4), is pulled tight from both ends. This is done before the last stitch of the hæmostatic suture is taken in the portal vein and vena cava. After this last stitch is completed a tight pull suffices to lock the suture and the ends may be dropped. A single stitch of the anterior row, *F*, is placed at the upper end, but is not tightened.

The assistant tightens and somewhat elevates the lower end of the hæmostatic suture while the operator cuts off the top of the tuck, first from the vena cava, then from the portal vein. Smooth thumb forceps and curved scissors are used. An elliptical strip of vein from 1.5 to 4.0 millimeters wide and from 2.0 to 3.5 centimeters long is removed. The hæmostatic stitch may again be dropped or, if there is slight leakage at any point when unsupported, held lightly.

In Figure 5 we see that each vein has been opened for a distance of from 2.0 to 3.5 centimeters.

In Figure 6 the hæmostatic suture, *E*, is still in place. The anterior row of stitches, *F* and *F'*, is inserted from each end as a continuous infolding stitch. It is pulled up loop by loop from the vena cava side while the assistant makes sure of invagination of the cut veins. The knot is tied and the ends are cut.

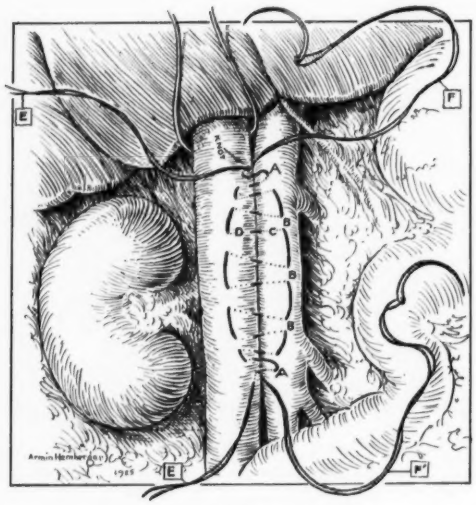


Fig. 3.

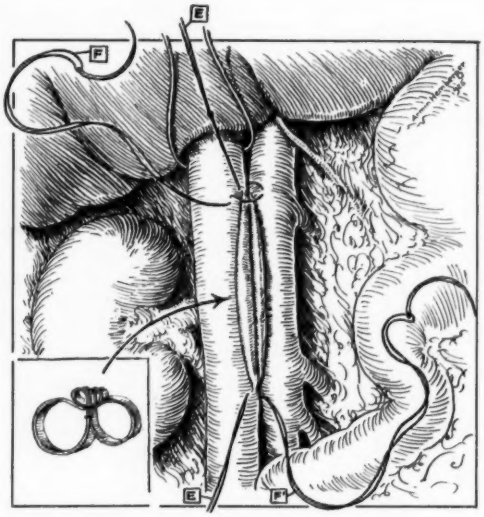


Fig. 4.

In Figure 7 the hæmostatic stitch has been carefully withdrawn, completing the anastomosis. The veins are now taken in the fingers and gently manipulated to make sure of thoroughly opening the fistula. Traction on the ligature around the vena cava before tying it causes slight engorgement of the portal vein and vena cava, and a tachycardia of 120 to 160 beats per minute. The vena cava is tied off and the abdominal wall sewed up in layers. Many abdominal veins which did not bleed on entering the abdomen are now seen to ooze and there is marked engorgement. The larger bleeders are tied but interference with the venous return is avoided as far as possible. The

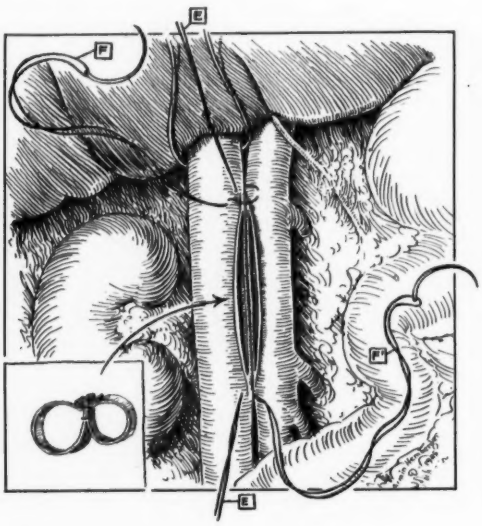


Fig. 5.

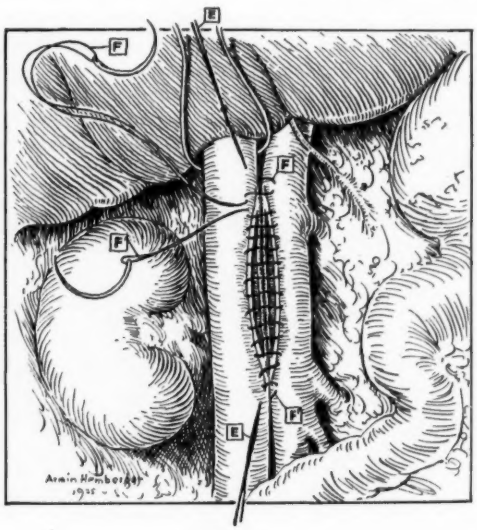


Fig. 6.

Fig. 8.

Fig. 9.

dog recovers from ether as the wound is closed and s in excellent condition. No special postoperative care is needed.

COMMENT

Several points in technique are important. As mentioned by Bernheim and Voegtlin (2), doubled silk should always be used, the two strands filling up the needle hole effectually. We have found, too, that oiling makes the silk slip through the vein walls more easily. In the continuous suture of veins each stitch should be put through the thicker walled vein last before tightening. This prevents tearing. If any point should bleed persistently a bit of muscle placed over it with the application of light pressure will stop it. If a needle breaks, leaving the pointed half in a thin walled vein, take another stitch close by, continue sewing until ready to pull up, then remove the fragment backward, and tighten the suture.

The main advantages of the method may be summarized in this manner:

1. No special instruments or specialized operative technique are necessary.
2. All steps are carried out deliberately under the direct vision of the operator.
3. The opening is oval, not linear.
4. There is no limitation within reason as to the length of anastomosis which can be made.
5. Veins much smaller than the portal of the dog may be anastomosed.
6. There is no puckering of vein walls with possibility of valve-like flaps or inclusion of tributaries as in methods which require a mattress suture for closing over the end of the anastomosis (2).

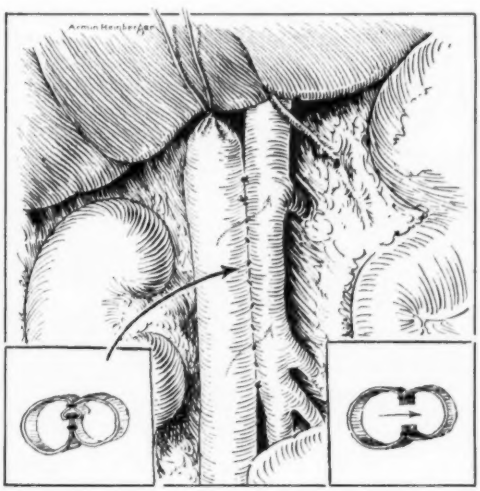


Fig. 7.

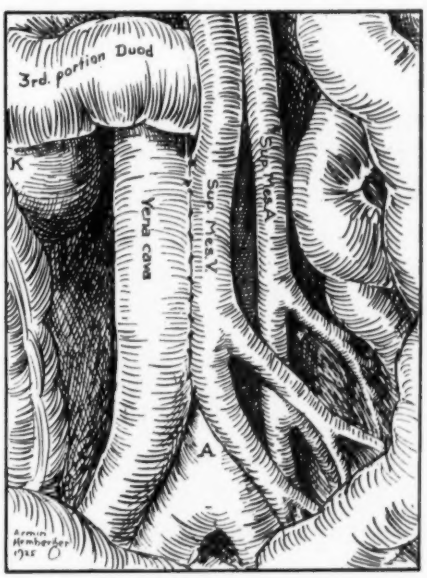
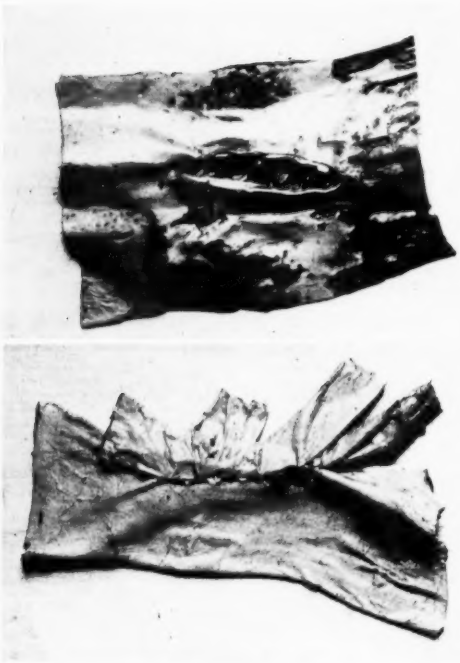


Fig. 10.



Figs. 11 and 12.

7. There is no loss of blood and no shock.

We have done eight of these operations on dogs varying in size from 9 to 20 kilos. Five were successful and examination at a subsequent operation showed functioning fistulæ in each case. Three dogs died because the edges of the fistula were not entirely separated, 2 within 18 hours and 1 after a period of 5 days. These fatalities were due to the fact that the veins were not manipulated after withdrawing the hæmostatic stitch. This is apparently a very important point and the manipulation should never be neglected. In the two dogs which died soon after operation the edges of the opening were close together and covered by a fine fresh thrombus along the entire extent of the vena cava side of the anastomosis. In the dog which died after 5 days only a portion of the anastomosis had opened, and this had gradually filled up by a thrombus propagated from the part which had never functioned.

Figure 8 shows a specimen removed 18 hours after operation. The veins were opened, the anastomosis filled with gauze and the specimen fixed in formalin for 24 hours before photographing.

Figure 9 shows healing in a specimen from a dog sacrificed one week after operation.

That the procedure may prove of use in human surgery is indicated by the fact that we were able to carry out the anastomosis of the inferior vena cava with the superior mesenteric vein in a cadaver. Figure 10 is a drawing showing the completed anastomosis and the important anatomical relations. Figures 11 and 12 are photographs of the cadaver specimen showing the anastomosis from the outer side and from inside the vena cava. Anastomosis of the vena cava with the portal vein in the human being immediately comes to mind.

SUMMARY

A method is described for anastomosing veins. No special instruments are necessary and the procedure may be carried out rapidly under direct vision with assurance of a successful outcome. A large, oval opening is provided.

I am indebted to Dr. Carlos M. Echandi, Yale School of Medicine, for assistance with the operating.

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CORRESPONDENCE

FINAL RESULTS OF OVARIAN GRAFTING

To the Editor: I have read with much interest Dr. W. Blair Bell's article on "Ovarian Grafting" in the December, 1925, issue of SURGERY, GYNECOLOGY AND OBSTETRICS.

The favorable results as mentioned by the author appear to me as extraordinary, especially when I recall my own experience in ovarian grafting. Considering the marvelous results claimed by Dr. Bell, I have sometimes wondered if the technique I use is not defective, but the more I compare Dr. Bell's technique with my own, the less I find any material difference between the two. I will describe the technique I use.

The ovarian tissue is carefully separated from the structures surrounding it. It is temporarily wrapped in a compress saturated with hot serum (40 degrees C.) during the primary operation and until it is time to implant it. After the ovary is scarified it is carefully placed in a pouch produced by separating the peritoneum and the posterior face of the rectus. The peritoneum and the abdominal wall are closed with the ovarian tissue implanted in the extra-abdominal pouch.

It was in Paris, during the year 1916, that following the example of Tuffier, I began to use this method of ovarian autografting. Since the war, back in Canada, I have used the method in 25 cases in patients who had undergone an operation for double salpingo-ovaritis without hysterectomy.

In the December, 1923, issue of *L'Union médicale du Canada*, I reported the results obtained as follows: In our experience, while the results obtained in ovarian grafting have not been encouraging, on the other hand the ovary grafted has never caused serious trouble and has apparently ultimately undergone sclerotic degeneration. In some patients (three), there was an absence of artificial menopause disturbances but such a condition was quite prevalent in patients in whom ovariectomy had been done without ovarian grafting. The menstrual flow would continue for some time when a few ovarian cells had been left, intentionally or not, in the pedicle.

And thus my experience leads to this conclusion: that medical and surgical therapeutics have failed in cases of ovarian insufficiency brought about through ovariectomy, that our knowledge of ovarian physiology is rather limited, that, though it is sad to admit defeat after such tenacious effort, it is best not to court delusion any longer through the practice of insufficient methods, but rather to try to find, by working with physiologists, some other means of dealing with the ovaries such as those we now use in dealing with the thyroid.

I may state, as does Sauvé, who has experimented in ovarian grafting, that one cannot scientifically infer that anatomical integrity becomes physiological integrity.

To demonstrate the truthfulness of this statement, I will describe briefly a case which I believe is conclusive. It is probably also the only case reported in the medical literature.

In September, 1925, a patient upon whom I had operated 5 years previously (1920) for bilateral lesions of the ovaries and the adnexa, came again to my surgical clinic. As I had made it a practice

Fig. 1. Sections of the ovarian tissue 5 years after a grafting. Section I. *A*, Stratum granulosum; *B*, theca; *C*, stroma; *D*, blood vessels. Section II. *A*, *B*, *D* enlarged. Section III. Stroma enlarged.

at that time to transplant ovarian tissue in the abdominal wall, this patient had undergone that treatment. But, as in other cases, the beneficial effects of the grafting had failed to materialize; in fact, I never have seen a castrated patient suffer so much as this one did by the complications of the menopause which had resulted.

This patient required a laparotomy for lesions having no connections whatsoever with the previous operation. I therefore grasped this unexpected opportunity to examine the grafted ovarian tissue and without complicating the operation I excised the grafted ovary. This was an easy matter, as we had the records of the operation done in 1920. The grafted ovary was found in its bed between the peritoneum and the posterior aspect of the rectus, half-way between the umbilicus and the pubis. By an incision extending beyond the limits of the entire organ, the ovary and all the surrounding tissues were taken out, including the smooth surface of the parietal peritoneum at the back and as far as the muscular fibers of the rectus in front. During this rapid intervention, we were able to note that the organ had decreased by about half its volume within the 5 years. After incision, the grafted tissue appeared enveloped in fibrous tissue; on cutting the tissues we noted a vascularization extending as far as the arterial flow. The anatomical integrity of the transplanted organ was thus conclusively established. But we were not satisfied with these proofs and so we submitted the organ for histological examination to professors Hingston and Jutras. They reported that the sections showed ovarian tissue; that there was a thick layer of large clear cells such as are found normally in true stratum granulosum; that these cells rested on a fibrous theca; that the stroma appeared normal; that vascularization was good; and that there were no signs of inflammation or degeneration.

It is thus evident, macroscopically and microscopically, that the grafted ovary in the abdominal wall had secured good nutrition, a relative autonomy, and an anatomical integrity, practically perfect, in view of all the conditions required for a successful grafting operation.

I see no reason why similar results should not prevail in most of the cases in my series, as the operations were done with scrupulous care according to the same technique in all cases.

How is it then, that in this particular patient, ovarian insufficiency persisted so stubbornly, as it has in most of the other patients operated upon by me for ovarian grafting?

In my opinion, the answer is simple: ovarian grafting performed under present known conditions does not insure *physiological integrity* of the organ; on the other hand it lives as a parasite carelessly and unconcerned as to its own internal secretion. All of this, likely, is because the nervous system which has a function to fulfill is not able to do so. Perhaps other physiological conditions of which we are still ignorant are lacking. At least this case is an example which teaches us the fate of grafted ovaries, and it reveals as well very clearly the therapeutic inefficiency of ovarian grafting.

One must have the courage to confess experimental failures. It would be too good to be true if by a simple surgical process the artificial menopausal troubles could be mastered.

From our experience I believe we are justified in saying that ovarian grafting is not more beneficial than testicle grafting from monkey to man, and having thus dealt so discouragingly with the subject of ovarian grafting let us try to seek anew, with the co-operation of physiologists and chemists, an efficient therapeutic measure to replace our present method.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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MARCH, 1926

MESENTERIC VASCULAR OCCLUSION

THE subject of mesenteric vascular occlusion is involved in considerable confusion and on account of the high mortality little effort has been made to disentangle the diagnostic signs and symptoms of these accidents which involve the intra-abdominal viscera. Embolus and thrombus of the mesenteric vessels are not infrequent accidents, and are rarely diagnosed prior to the opening of the abdomen for operative or postmortem purposes.

In clinical diagnosis the first element of confusion is that many authors include embolus and thrombus as causes of intestinal obstruction without differentiation. It is true that they may cause obstruction. Another element of confusion is the difficulty of determining on the operating table whether the trouble is in the vein or the artery, and whether it is from an embolus or a thrombus. Still another element of confusion is that so large a proportion of the reported cases are postmortem studies, which never received surgical analysis during life. This difficulty has led at least one prominent writer to coin the term "mesenteric vascular occlusion" as sufficiently inclusive to fit all cases.

A study of the literature would lead one to conclude that surgeons coming on the condition unexpectedly at the operating table have not made much effort to trace back the clinical history for diagnostic signs and symptoms for future guidance. In fact, a large proportion of these cases seem to have been considered as terminal conditions of long standing cardiovascular disease and they are not given serious surgical analysis. We must admit the difficulty of pre-operative diagnosis, yet the condition has very definite signs and symptoms, especially in the more acute cases. The presence of an acute abdominal condition in a patient in which the cause cannot be made out and especially in one having well-marked cardiovascular sclerosis should always put the surgeon on guard for the possibility of a "mesenteric vascular occlusion." While in embolus the insult is much more acute, in thrombus the symptoms bespeak an increasing area of intra-abdominal involvement, extending over a varying length of time. The symptoms which involve only a vascular branch are necessarily different in both degree and intensity from an involvement of a main vessel. If prompt recognition of the condition which involves only moderate areas could be developed, surgical intervention would yield good results. A review of the literature beginning with the exhaustive studies by Porter, Jackson and Quimby, published in the *Journal of the American Medical Association* in 1904, and a few later writers, shows serious attempts to secure a better basis of the causes, signs, and symptoms of occlusion of a mesenteric vessel.

To be able by analysis of the cardiovascular history and the immediate signs and symptoms to determine the nature of the intra-abdominal insult does not end the problem, as far as the surgeon is concerned. In at least one case studied after the abdomen was opened the surgeon was able to decide, after watching the circulation for a short time, that the badly discolored intestine was already beginning to improve under its collateral circulation. Possibly, the temporary relief of intra-abdominal pressure while the abdomen was open may have contributed to the favorable outcome. The abdomen was closed without operative interference with the intestine or mesentery and a good recovery followed.

Immediate recovery does not end the patient's danger. The impairment of the intestinal circulation and the large amount of transudation of bloody serum through the peritoneal surfaces may lead to subsequent multiple obstruction from mass adhesions. In one such case it was necessary, three years after the attack, to anastomose the ileum into the descending colon.

With improved methods of operation and especially with the development of safer anæsthetics and technique of inducing anæsthesia, these cases can come to operation early with greater assurance of success. Such cases furnish a fertile field for clinical and experimental study of the sequence of events leading up to and following occlusion of the mesenteric vessels. CARL E. BLACK.

EXCISION AND REPAIR IN THE TREATMENT OF CANCER

TWO seemingly divorced fields of surgery, during the past few years, have received much discussion and intensive study. In the one the surgeon has received the advice and experience of interested and enthusiastic observers who have approached the treatment of malignancy from many angles other than surgical removal. In the other a comparatively small group of surgeons with careful attention to nomenclature, with original thought and trial, have refined the details of tissue transference to a point at which anyone following their descriptions may successfully accomplish the most satisfactory of all efforts—construction, particularly that which we speak of broadly as plastic surgery.

The discussion of these two fields together may seem strained, but it must be apparent that the fundamental effort of one, by whatever agent, is destruction; while the whole purpose of the other, by whatever method, is construction. If two diametrically opposed surgical principles are merged, may not the result of equalization, or at least neutralization be expected?

The treatment of cancer is one of the most interesting, if not the livest problem in surgery today. The uncertainty of cure by any method, the multiplicity of form, not only in relative pathological activity, but of location and superimposed changes, are enough to stir one's interest from purely scientific reasons, while the horrible picture of the terminal case can only emphasize the importance of the study if we are to hold to the humanitarian aspects of our profession.

The introduction of new and valued agents of destruction into the treatment has now increased the modes of attack to a point where we must decide upon the merits of surgery; select this or that agent alone, or in combination. Combination brings up the added question of sequence.

A mere rehearsal is sufficient to explain the ever increasing uncertainty: keen excision with or without dissection of nodes; cautery excision with or without dissection, cauter-

ization in position with or without regard to heat penetration; quite a number of electrical principles of which endothermy is the newer one; chemicals in several combinations; radium with various plans of application, introduction, degree of dosage, filtration, time and frequency of treatment; X-ray, involving the same questions with penetration depth added. Possibly in the future, serology may enter into trial. With a host of clinical pictures on the one hand, with an ever increasing group of agents on the other, the question of treatment presents many phases.

Surgery either as a primary effort, or secondary to assist the introduction of destructive agents, will always maintain a place in the care of internal cancer because in no other way can the situation be determined. In external and accessible malignancy there is the inviting group for the study of the action of this great number of destructive factors.

Primarily all methods are studied and advanced with the hope of an universal cure, but it is apparent that the multiplicity of situation precludes any such answer, at least with our present knowledge. There is no single plan without very valid objections, which are generally known. There appears a tendency in recent years to use that or those of one in support of the use of the other, a tendency to place the treatment of cancer on a competitive basis.

Trial, experience, and accumulation of data are necessary to test the value of these plans and locate their use. There is no question but what the study is activated by the highest motives but it is equally true that concentration on one line, whether it be surgery or otherwise, leads to use without due consideration of the case. It may be an exaggeration to say that there is now a greater tendency than ever to apply treatment upon the blanket diagnosis of cancer.

With all these things in mind the indications of the future point positively and directly to the effort to group conditions not only with exact study of the cellular picture but with regard to location and careful consideration of superimposed and extraneous influences. Whatever pathologists may generally think of Broder's group, and it must permit of wide personal interpretation, nevertheless it presents a most important effort, and may lead further in the grouping of cases in the consideration of plans for treatment.

Will it not be an advantage to pause in our discussion of the relative merits of agents and consider that the whole question of treatment revolves around the choice of only two possible methods of attack: excision on one hand, destruction in position on the other. Upon which procedure lies the greatest expectation of a cure?

All attempts at destruction in position are open to an important objection—uncertainty of accomplishment. The result can be interpreted only by appearance. The possibility is ever present that activity is only arrested and not completely inhibited. The end-result is contraction or scar formation of once diseased tissue remaining in place. All attempts at excision may end in loss of function or a cosmetic deformity. Such result is the most fearful. In fact it appears that fear of surgery and its scars is the most potent factor in causing the greatest handicap in the treatment of this disease—delay in *seeking advice.* The surgeon is also influenced with an estimable desire to leave a minimum scar, to make a close instead of a wide excision.

Whether it will ever be possible to agree generally upon the relative merits of the primary procedures, whether it will ever be possible always to recognize their limitations or formulate plans for their use in combinations, it is nevertheless true that the objec-

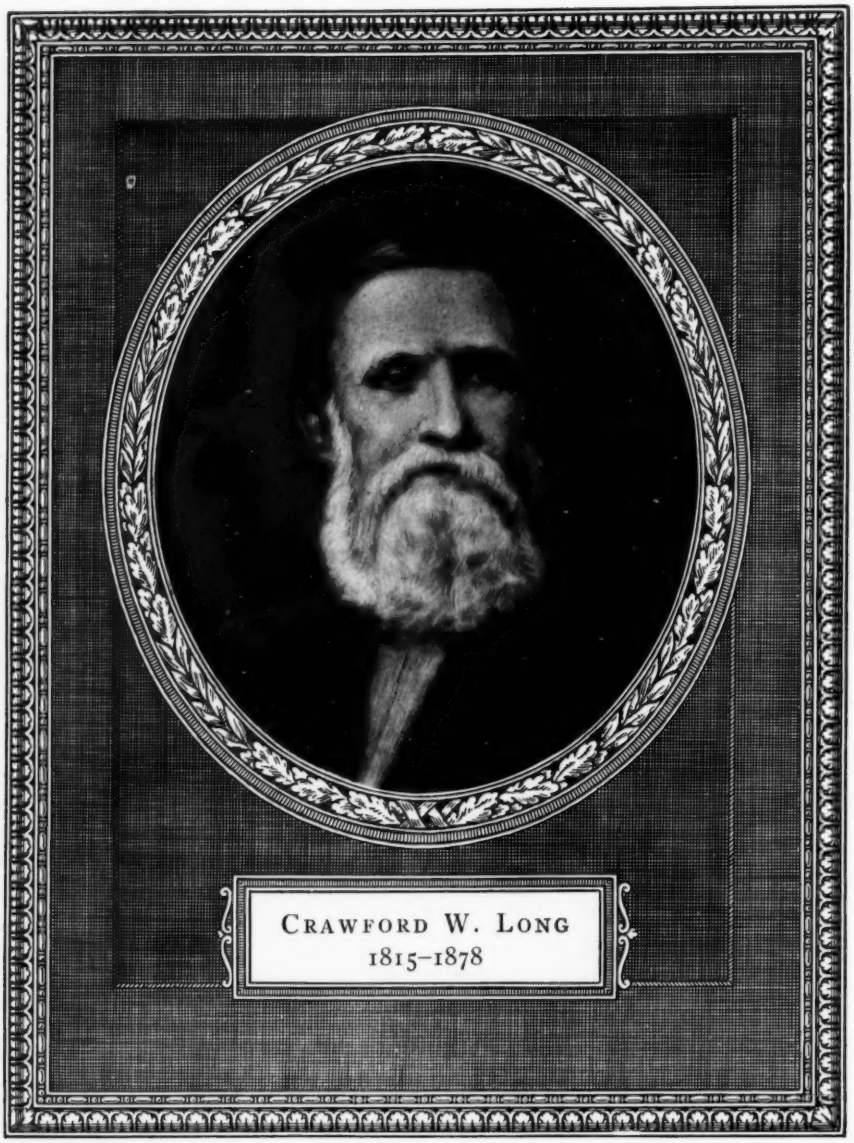
tions to destruction in position will always remain, while the fearsome objection to excision has been largely erased by the wonderfully successful procedures of tissue transference. And those of us who believe that the hope of a cure is a local growth widely removed can approach and offer our patients plans not only for a cure but for reconstruction.

The more frequent use of the full thickness graft in the Wolfe-Krause form is a great forward step. With attention to details and selection, this graft revascularizes and leaves a hardly appreciable scar and it is of great use in exposed areas. The small deep graft of Davis does not yield such good cosmetic results and is not to be considered for exposed places. It has its greatest field in hastening the healing of granulating surfaces following cautery excision.

The Ollier-Thiersch form is by no means to be discarded but its limitations are more to be recognized, principally in its greater tendency to contraction and color loss. It is well known that this graft will take on the function of mucous membrane and again with attention to details will take in the mouth in spite of the unfavorable field. There is also much keener understanding of the differences between grafts and flaps and a fuller appreciation that these are two distinct principles, entirely separate in their application. The use of the flaps—the sliding, the jump, the tubular, the delayed; the possibility of transferring grafts as a part of the flap to make two sided epithelial coverings for the cure of defects of nose and cheeks; New's delayed flap on the palate, not only of inestimable value in congenital cleft palate but for closure of all defects of the palate or alveolar process; the splendid work in reconstructive dentistry, the study of compounds for prosthetic models, —these procedures and their accomplishment all indicate that we must inject into the treatment of cancer not only the effort at cure but also that of repair.

This is surely no new thought but one waiting development with the anticipation that cases will group themselves along lines of pathology and selective reconstructive steps. Groups in which is indicated keen excision and immediate repair; others in which cautery excision may be used, followed by delayed, either early or remote repair. The wisdom of excising all areas apparently cured by other means must also be considered.

While there are many paths from out the Wilderness of Cancer Treatment, that which appears broadest and most direct is a local growth widely removed either primarily or secondarily and the substitution of tissue of known value. HARRY P. RITCHIE.



CRAWFORD W. LONG
1815–1878

MASTER SURGEONS OF AMERICA

CRAWFORD WILLIAMSON LONG

CRAWFORD WILLIAMSON LONG, the discoverer of surgical anæsthesia, was the scion of distinguished ancestors. His progenitors immigrated from the north of Ireland to Pennsylvania and Virginia. One grandfather, Captain Samuel Long, fought through the Revolutionary War under Washington. Edward Ware, his maternal grandfather, was a sergeant under LaFayette. After the war, the Longs of Pennsylvania and the Wares of Virginia moved to Madison County, Georgia, where both Revolutionary heroes are buried, their graves being marked by the United States Government in commemoration of their patriotic services. James, the son of Captain Samuel Long, became one of the most prominent and influential men in Georgia. He married Elizabeth Ware and from this union sprang Crawford Williamson Long.

Crawford Long entered Franklin College, now the University of Georgia, at the age of fourteen years, taking the degree of A.M. at nineteen, standing second in his class. His roommate and best friend was Alexander H. Stephens, who became vice-president of the Confederacy. Young Long took one year of medicine in Transylvania University. From there he went to the University of Pennsylvania, graduating in two years, class of 1839.

To have graduated at the University founded by Benjamin Franklin is no mean distinction. The biography of the famous men who have taught or graduated there, including Benjamin Rush, almost makes the history of American medicine and surgery. During Long's attendance the Faculty included Philip Syng Physic, the first surgeon to use buried sutures; William Gibson, who tied the common iliac and did two cæsarean sections on the same woman; Nathaniel Chapman, George B. Wood, Hoover, Hodge, Hare, et al. These were the men who taught young Long. Wood never failed to admonish his students to be cautious in announcing new discoveries. Jenner waited twenty years before publishing his discovery of vaccination. Wood's teachings evidently left their impress upon Crawford Long.

Following graduation Dr. Long spent eighteen months in New York City "walking the hospitals." He gave special attention to surgery and attained an enviable reputation in his work. Returning to his native state, Dr. Long located at Jefferson, a country village. Possessing a pleasing personality, and coming

from the greatest university of his day, he soon acquired a large practice and became a social favorite as well.

Dr. Long married Miss Caroline Swaim, daughter of the president of the University of North Carolina. Fourteen children were born to them, two of whom, Miss Emma Long and Mrs. Frances Long Taylor, are still living in Athens, Georgia, where the family moved in 1851. They are the custodians of an enormous amount of literature that has gathered around the history of their father's great discovery.

The inhalation of nitrous oxide to produce mental exhilaration, or a species of intoxication, was known and practiced during the early part of the nineteenth century, both in Europe and America. The introduction of this custom was due originally to certain chemists, and later its use was broadcast by itinerant lecturers. It was noticed that when the inhalation of nitrous oxide was pushed far enough stupefaction ensued, and the subject became unconscious. Wells (1844) got his inspiration from this source, and the next day had one of his sound molars extracted while he was under the influence of the gas. Mr. Davey, afterward Sir Humphrey, called attention to the effects of nitrous oxide as early as 1800 and suggested that probably it might be used to prevent the pain of a surgical operation. In the same year William Allen demonstrated the phenomena of nitrous oxide inhalation to Sir Astley Cooper, at Guy's Hospital, noting especially the loss of sensation to pain. While that famous surgeon had eyes to see and ears to hear, his spiritual vision failed to discern the wonderful secret that was revealed before him, and for which the profession had sought since the beginning of time. And the world shuddered on under the agony of the surgeon's knife.

It was also observed that sulphuric ether, which had set upon the Apothecaries' shelves for three hundred years, would produce exhilaration and stupefaction as did nitrous oxide. Faraday said in 1818 "When the vapor of ether, mixed with common air, is inhaled it produces effects similar to those of nitrous oxide gas." Ether, by inhalation, to relieve the spasm of asthma and phthisis, was used by Pearson, of England, as early as 1795. Numerous American physicians employed ether for the same purpose. However, it was the social use of both ether and nitrous oxide to produce a pleasurable exhilaration, for which they were chiefly used. Prof. Thompson, of Edinburgh, frequently entertained his students by exhibition of the exhilarating effects of both sulphuric ether and nitrous oxide. But no one coupled up the anæsthetic effects of ether with a surgical operation.

While Crawford Long was attending lectures in Philadelphia, the inhalation of ether to produce mental excitement, according to Mitchell, was common practice among the lads in that city. It is of record that Long indulged in the favorite pastime himself. The same custom prevailed in New York.

Shortly after Dr. Long located in Jefferson he introduced the use of ether by inhalation for its exhilarating effect. Dr. Long's "ether frolics" soon became

quite popular in that part of the state. As the result of his observations of persons under the influence of ether, he concluded that an operation might be performed while a patient was under its influence and without pain. But let us have the story in Long's own words: "On numerous occasions I have inhaled ether for its exhilarating properties, and would frequently, at some short time subsequent to its inhalation, discover bruises or painful spots on my person, which I had received while under the influence of ether. I noticed my friends, while etherized, received falls and bangs, which I believed were sufficient to produce pain on a person not in a state of anæsthesia, and on questioning them, they uniformly assured me that they did not feel the least pain from these accidents. These facts are mentioned that the reasons may be apparent why I was induced to make an experiment in etherization. . . .

"The first patient to whom I administered ether in a surgical operation, was Mr. James M. Venable, who then resided within two miles of Jefferson, and at present (1849) lives in Cobb County, Georgia. Mr. Venable consulted me on several occasions in regard to the propriety of removing two small tumors situated on the back of his neck, but would postpone, from time to time, having the operations performed, from dread of pain. At length, I mentioned to him the fact of my receiving bruises while under the influence of the vapour of ether, without suffering, and as I knew him to be fond of and accustomed to inhale ether, I suggested to him the probability that the operations might be performed without pain, and proposed operating on him while under its influence. He consented to have one tumor removed, and the operation was performed the same evening. The ether was given to Mr. Venable on a towel, and when fully under its influence, I extirpated the tumor. It was encysted and about one-half inch in diameter. The patient continued to inhale ether during the time of operation, and when informed it was over, seemed incredulous, until the tumor was shown him. He gave no evidence of suffering during the operation, and assured me after it was over that he did not experience the slightest degree of pain from its performance. This operation was performed on March 30, 1842."

Dr. Long continued the use of sulphuric ether as a surgical anæsthetic, his operations being of record. He published his epoch-making discovery by word of mouth tc all with whom he came in contact, by doing operations in the presence of reliable witnesses and by urging other physicians to use ether as a surgical anæsthetic, until it was said that his method became "notorious" throughout that part of the country among both the profession and laity. Later (1849) in a paper read before the Georgia State Medical Society, and published in the *Southern Medical and Surgical Journal*, he gave a full account of his discovery.

Documentary evidences of the above statements are published in *Old Penn*, vol. xiv, No. 1, October 2, 1915, and elsewhere. They are so convincing that they cannot be gainsaid. Practically everyone, both in America and Europe, who has

investigated this subject, admits that Crawford Williamson Long was the first to employ sulphuric ether as a surgical anæsthetic. Many papers, pamphlets, and a few books have been written setting forth in great detail the history of Long's discovery. Numerous monuments have been erected to his memory. Many scientific bodies have declared their belief in Long's priority. His Alma Mater in 1910 unveiled a medallion with imposing ceremonies to commemorate Long's discovery.

In 1902 Congress enacted a law authorizing each State to place a statue of two of its most distinguished citizens in Statuary Hall which is located in the Capitol directly under the dome. The State of Georgia, through its Legislature selected Crawford W. Long and Alexander H. Stephens as its most illustrious representatives. In March of this year the Memorial Association of the Discoverer of Surgical Anæsthesia will unveil in Statuary Hall a statue of Crawford W. Long made of Georgia marble by the famous sculptor, J. Massey Rhind, New York City.

That Wells in 1844 used nitrous oxide as an anæsthetic, and Morton in 1846 employed ether disguised with aromatics, and under the patented name of "letheon," does not in any way invalidate the fact of Long's priority claim as the discoverer of surgical anæsthesia in 1842.

In the ringing words of Henry W. Grady: "It was Crawford W. Long who gave to the world the priceless boon of anæsthesia." When Edward VII was operated on for appendicitis, his first question on awakening was "Who discovered anæsthesia?" His surgeon, Sir Frederic Treves, answered: "It was an American, Your Majesty, Crawford W. Long."

JOHN WESLEY LONG.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 18, 1925, WITH THE PRESIDENT, DR. DAVID S. HILLIS, IN THE CHAIR

REPORT OF CASE OF SARCOMA OF UTERUS

DR. W. C. DANFORTH: The patient was a woman of 63 years, who had ceased menstruating about 12 years previously. She developed a tumor in the pelvis which was diagnosed by her physician as a fibroid. I later found a circumscribed tumor of the uterus which was freely movable. Material obtained by curettage showed a spindle-cell sarcoma. Complete hysterectomy was done. The tumor was confined to the uterus except in one of the large veins of the right broad ligament into which there was an extension of the sarcoma. On the posterior wall there was a breaking through of the capsule. There was apparently no secondary growth. The woman made a good recovery and went home, but soon developed a metastatic arthritis. She died about 4 months after the operation from cerebral hæmorrhage. Up to the time I saw her last, about a month before her death, no secondary growth had developed.

Sarcoma of the uterus is rather rare. This is only the second one we have had in the hospital. The other one was not my case.

SURGICAL MANAGEMENT OF THE ACUTE ABDOMEN

DR. W. M. THOMPSON read a paper on the "Surgical Management of the Acute Abdomen." (See p. 368.)

DISCUSSION

DR. C. W. BARRETT: In regard to peritoneal infections, clinically we always think of the reactions against infection as a disease. We are mostly teachers here and in the light of our present knowledge of pathology, our literature a few years hence is going to look rather peculiar when it refers to a patient dying from peritonitis; a salpingitis extending to a peritonitis; a local peritonitis extending to a general peritonitis; etc. In a case of peritonitis, a patient is sick of the peritoneal infection and if the patient dies, it is in spite of the peritonitis, not because of it. Peritonitis is a protective process, as are all the other "itises" as well. It is perfectly possible for it to be protective in nature, and yet in the end, result in deleterious action. This explains the adhesions patients get with peritonitis; intended to save the patient, adhesions may be produced that cause obstruction of the bowel and help to destroy the patient. We always should keep in mind that reaction after infection is for and not against the patient.

DR. WILLIAM MCI. THOMPSON (closing): This subject has interested me, particularly along the lines Dr. Barrett mentioned. One point is quite important. We are learning a great deal about acute abdominal diseases and as we do, we are going to handle such cases much better. Two cases of rupture of the gall bladder and one of rupture of the common duct have been very instructive in the line of conservative handling and careful surgery not too radical. As we learn the real pathology behind these cases and realize the part the peritoneum plays in protection we are better able to reduce our mortality.

NON-SPECIFIC ANTIGENIC EFFECTS OF SPERMATOZOA UPON FERTILITY

Dr. S. J. Fogelson (by invitation) read a paper on "Non-Specific Antigenic Effects of Spermatozoa upon Fertility." (See p. 374.)

DISCUSSION

DR. SYDNEY SCHOCHET: I would like to ask Dr. Fogelson if he uses the same male guinea pigs with the same litter in females? If not, it will be difficult to discuss the paper. It is very difficult to express true enzymic action unless you carry out the experiments on a purely mathematical basis. Another fact difficult to understand and one of the most important in the study of enzymes, is a static and dynamic element. The study of the static element is conducted in living tissues and of the dynamic in dead tissues. We all know, for instance, the action of pepsin on any protein and yet there is a difference in the action of pepsin obtained from the same animal. While you get a breaking down of the protein there is a difference in the relationship of the digestive action. From the standpoint of formal attack on digestion there is some effort taken in the stomach by digestion. This study has been carried out by Robertson.

In this other work we must recognize the static and dynamic factors and the question of sensitization of the spermatozoa in relation to follicular

enzymes. I have found similar results, except with this degeneration you get a marked degeneration of the brain when you use spermic injection.

I would like to know if Dr. Fogelson found similar changes in the brain. This work suggests a new theory in dementia præcox which sets out to show that there occurs a destruction or auto-destruction of spermatozoa in the individual with degeneration of the brain tissue. The agglutinins are probably the most important and if one could work that out it would throw most light on the question of sterility.

While this paper is extremely interesting and is going to open a new line, unless you carry it through you are going to be led into blind alleys; in other words, you have to use the same animals in the beginning as in the end of your experiments.

Dr. Mark Goldstine: I think this paper reasonably eliminates any idiopathic sterility when both sides are apparently normal; and also the theory that the vaginal secretion can clump the spermatozoa and so prevent pregnancy. Of the 17 cases that Dr. Fogelson spoke of, 7 are pregnant. One of them has one child, delivered November 13, 1925. We will probably have to eliminate the clumping of the spermatozoa by the vaginal secretion as a factor in causing sterility and look carefully for gynecological troubles. Often these troubles are of minor character and when corrected pregnancy follows.

Dr. N. S. Heaney: Will Dr. Fogelson tell us the technique he used in the 17 human cases to determine whether there was clumping of the sperm with the secretions of the female.

Dr. S. J. Fogelson (closing): In answer to Dr. Schochet to use the same animal would be impossible. The animal was destroyed and the spermatozoa were taken out and placed in isolated salt solution.

Dr. Schochet's point is very well taken but there is another factor he apparently overlooked. To wit; it has been demonstrated that in rodents at least, normally there is invasion of the genital mucosa by spermatozoa. This recently has been reported by numerous workers in California. If that occurs normally we can eliminate this static and dynamic factor which is present in sterility.

In regard to autopsy on the rats, I did very little microscopic work on sections of the brain. Grossly there were no changes. I am not in a position to state whether that is a factor even though it occurs. If invasion of the mucosa does occur we can cease to worry about static and dynamic effects because this is a normal state of affairs.

In regard to the clumping found in the cervical secretion, we were very careful in all these patients at the time we were doing the Rubin air test to obtain smears from the cervical secretion. We determined the hydrogen-ion content here with variations from 10 to 5. With that as a basis we took the cell or extracts of our smears and tested them out in hanging drops with spermatozoa.

UNIV. OF MICH.

CONSTANTINI
AFRICANI MEDICI DE HVMA-na natura, uel de membris principalibus corporis humani, Liber I.

De cerebro.

CErebrum natura frigidum & humidum eſt, ideo ut & facile ad ſuſceptionem diuerſorum conuerteret, & ut mouentibus membris mobilitatem præſtaret, & ut calido & ſicco ſpiritui ad caput exhalanti temperiem inferat. Cuius miringa frigida eſt & ſicca & tenſa. Infra quam ſunt diuiſiones tres. Prima dicitur phantaſtica. Secunda rationalis. Tertia memorialis. Inter phantaſticam & rationalem eſt pannus quidam frigidus & ſiccus, & depreſſior eo qui diuidit inter memoriam & rationem, habens in ſe modicum tenuiſſimę carnis. Ex memoriali uero procedunt duo cānales tenues & humidi, ut medulla ſpinalis quæ penetrauit compaginē totam, & ueniunt uſq; ad phantaſticam cellam, per quos poſſit phantaſticus ſpiritus & rationalis commendari memoriæ, & iterum memorialis duci ad rationem & phantaſiam.

De auribus.

CViq; auri ſupraponitur unum os frigidum & ſiccum, & ſine ſpiritu quæ inferius adhærent illi tenui panno qui diuidit inter phantaſiam & rationem. Quibus ſunt ſingula foramina, in obliquum facta, habentia tenue initium ab ipſo panno. Quæ intrinſecus habent indumentum tenuiſſimum frigidum tum & ſiccum, per quod ducitur ſpiritus ab ipſo interiore panno, præſtans auribus uirtutem audiendi. Et eſt audibilis qualitas calida & humida, ut qualiſcunq; ſonus infertur auri ab humiditate ſuſcipiatur, à calore attrahatur ad cerebrum, ut ſciatur qualis ſit. Siccitas uero oſſium ad hoc eſt, ut tinnitus in eis per eque obſeruetur, ſecundū exteriorem euentum.

De oculis.

OCulorum autem tres ſunt tunicæ interiores frigidæ & humidæ. Prima eſt ut aqua coagulata lucidiſſima in qua uirtus uiſibilis eſt. Secunda eſt ut tenue oui album. Tertia ut uitrum modicum

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., Omaha, Nebraska

CONSTANTINUS AFRICANUS

THE Arabian school held the foremost position in the medical world beginning with the eighth century. Continental Europe, however, though to a great extent quiescent, had nevertheless not neglected either medical practice or teaching. There the direction of medical matters had passed over gradually from the lay physicians to the clergy. The monks assumed control of the teaching and carried it on in several institutions, though at first more in a practical than a theoretical way. One of the first of these schools was the monastery of Monte Cassino. This had been founded by St. Benedict himself on the site of an old temple of Apollo to be used as a place where the sick could come for treatment and where St. Benedict might have the opportunity to work his remarkable cures. These cures were collected by one of the later abbots, Desiderius (born 1027), and left by him as "Four Books on the Miraculous Cures of St. Benedict." The quality of these cures might be questioned as the following incident shows. Henry II, the Emperor of Bavaria, was believed to be afflicted with the stone and came to Monte Cassino for a cure. Henry was a prominent monarch, and St. Benedict apparently not wishing to cause him any undue inconvenience himself exerted his special power and removed the stone by lithotomy while he was asleep and then healed the wound at once. That this was done was proven by the fact that when the Emperor awoke, the stone was in his hand. What more could be desired.

St. Benedict apparently wished this great power which he had to be his and his alone so, as the founder of the monastery, he forbade the teaching of medicine there. This prohibition was soon broken and its abbot Berthanus taught medicine both orally and by writing and Monte Cassino held its position as one of the great, if not the greatest, school in Italy until its reputation was eclipsed by the school of Salerno. During the ninth and tenth centuries this monastery held its position principally through the reputation gained through its association with the miracles of St. Benedict; but as time went on something more was needed. Arabian medicine had gradually been improving. As yet its teachings had not crossed the Mediterranean into Europe, but it was only a question of time when they would do so. The only unsettled point was the means by which this would be accomplished. The agency turned out to be a Carthaginian, by name Constantinus Africanus, who was born some time during the first quarter of the eleventh century. After receiving his preliminary education, where is not known, he is supposed to have travelled many years throughout the east including Egypt and India to satisfy his thirst for medical knowledge. Finally he returned home. Whether he entered into practice or not is not established but shortly after his return he was accused of being a sorcerer and finally his life was threatened. One can imagine the feelings of this man who had spent years in the pursuit of knowledge, possibly one of the most learned men in Carthage, desirous of communicating the results of his labors to others, met with accusations of this character, which, as human nature has not changed much, were probably started by competitors, mediocre or less than mediocre, who were jealous of his attainments. One can see him, sick at heart, disgusted with the world in general, in fear of his very life, leaving his native land and fleeing to Italy. There he went to Salerno and joined the famous school, teaching for a time. Still being in the world of men and apparently not satisfied he went from Salerno to Monte Cassino where he joined the order, became a monk, and sought peace and respite from worldly cares and disappointments in the monastery where he could study and write his books which served to bring the medicine and surgery of the orient to the western world.

From this sketch of what is known of his life, one would not expect to find much that was original in his work. There may have been some work which he originated but as he does not give the sources from which he obtained his knowledge and makes no differentiation between his own work and that of others it is not possible for us to tell the difference. The work was published from his manuscripts some centuries later. It was translated by him from the oriental languages into Latin which Baas calls "barbarous." The work which I have had the privilege of examining consists of three parts: "An Anatomy; a Discourse on Elephantia; and Medicaments Obtained from Animals." It was published at Basle by Henricus Petrus in August, 1541,[1] with works by other writers. Constantinus Africanus deserves recognition as the introducer of Arabian and Oriental medicine into Italy and as the means of initiating the subsequent supremacy of occidental surgery.

[1] Reviewed through the courtesy of the John Crerar Library, Chicago.

REVIEWS OF NEW BOOKS

RECENTLY Ruhräh has published a monograph[1] which adds one more item to the more popular distribution of the writings of the early workers in medicine. He presents William Cadogan, one of the great physicians of the eighteenth century. Knowing nothing of infection and its causative factor in the production of disease, Cadogan sets himself to prove that gout and allied diseases are due to mistakes or excesses in living. These he classifies under three heads; indolence, intemperance, and vexation. If his premises had been correct his conclusions would have been inevitable, his reasoning is so clear. The book is well worth reading, not only as a matter of medical history but also as showing how a medical subject may be made attractive by a pleasing style. ALFRED BROWN.

CIMINATA of the Royal University of Rome has written an exhaustive analytical review of our present conception of gastric secretion,[2] and has based his conclusions on extensive research work.

Among the more important conclusions reached in this excellent work are the following:

1. There is a direct relation between the water content of food elements introduced into the stomach and the amount of gastric secretion.

2. There is a direct relation between the quantity of gastric secretion and the time interval between food ingestion and the appearance of gastric secretion. Meat stimulates abundant and early secretions; bread is a slow stimulant and gastric secretion on a bread diet is scanty.

3. Some foods (meat, potatoes) create a maximum secretion in the first hour after eating; milk, bread, rice, etc., delay maximum secretion.

4. Water, *per se*, brings about a scanty gastric secretion of short duration.

5. The percentage of acidity depends on rapidity of secretion and is not influenced by the kind of food ingested.

6. Peptic potency of gastric juice is influenced by the kind of food ingested; it is highest for bread, less for meats, least for milk.

The author believes that gastric secretion is an adaptation of glandular activity to the kind of food exhibited; he also believes that most foods contain in varying amounts the chemical elements which stimulate gastric secretions.

The experimental finding that water, added to food, increased the digestibility of the latter will be challenged by many dietitians. Ciminata, using dogs, proved that a dry bread meal was very slowly digested and that the addition of water to the bread increased the rapidity of digestion in the stomach. The same diet given to dogs with Pawlow stomachs brought out the fact that, with a dry bread meal the gastric secretions were scanty and of long duration, whereas a water-bread meal produced abundant secretions of short duration.

Experiments lead the author to conclude that gastric secretion is intermittent and not continuous. In his opinion, normal gastric movements, during digestion, are dependent upon the acid secretion present and vary with the intensity of the latter.

A most valuable monograph for physiologists and surgeons interested in the physiological problems of gastric surgery. GEORGE DE TARNOWSKY.

NO APOLOGY is needed for any publication which may spread a greater knowledge of the means by which cancer can be recognized in its early stages. The question of malignancy confronts every practitioner of medicine, from the isolated country physician to the highly trained specialist in his well equipped hospital. Since there is no specific test for carcinoma and since the treatment is early surgical removal, the profession eagerly awaits, from the highly trained specialists, their experiences in diagnosing and treating carcinoma in their respective fields. This was the purpose of the Post Graduate Lectures on Cancer,[3] delivered under the auspices of the Fellowship of Medicine and edited by Mr. Herbert J. Paterson. In no one small volume are there incorporated so many valuable data on cancer. One may be pardoned in mentioning the individual contributions: An interesting preface by Sir John Bland-Sutton, medical aspects of cancer by Sir Thomas Horder, general pathology of cancer by Archibald Leitch, cancer of the larynx by Sir St. Clair Thomson, carcinoma of the œsophagus by H. S. Souttar, the early diagnosis of cancer of the breast by W. Sampson Handley, cancer of the stomach by Herbert J. Paterson, cancer of the uterus by Victor Bonney, cancer of the intestines by Cyril A. R. Nitch, malignant tumors of the kidney by R. H. Jocelyn Swan, cancer of the bladder by J. Swift Joly, and the pathology, symptomatology, diagnosis, and operability of cancer of the rectum by W. Ernest Miles.

There are conflicting ideas and one is impressed by the optimism of Sir St. Clair Thomson and the pessimism of H. S. Souttar. The article by Miles demands respect due to his pre-eminence in this field and is the outstanding feature of the volume.

J. A. WOLFER.

ONE of the most confusing problems in clinical medicine is the interpretation of certain vague yet annoying gastro-intestinal complaints. Every surgeon has operated upon a patient on a diagnosis of gall-bladder disease or more especially chronic

[1] WILLIAM CADOGAN (His Essay on Gout). By John Ruhräh, M.D. New York: Paul B. Hoeber, 1925.

[2] LA SECREZIONE GASTRICA. By Dott. Antonino Ciminata. Bologna: Licinio Cappelli, 1925.

[3] CANCER. Post Graduate Lectures, Delivered under the Auspices of the Fellowship of Medicine. Edited by Herbert J. Paterson with preface by Sir John Bland-Sutton, LL.D., F.R.C.S. New York: William Wood & Co., 1925.

appendicitis, only to find the suspected organ normal. In many instances a gall bladder or an appendix is removed and yet the symptoms for which the patient sought relief, persist. A close study of a large series of such cases not infrequently reveals the fact that some energetic surgeon has performed a gastro-enterostomy for relief of symptoms only to find that the symptoms have been aggravated instead of mitigated.

It is pleasing to note that a considerable number of gastro-enterologists and surgeons have observed colon pathology and its attending disturbed physiology; yet so far as the reviewer knows, no definite working plan as to diagnosis and treatment has been established. We are all more or less familiar with Lane's ideas both as to the possible causes and results of colonic stasis and his radical form of treatment. The latter has spelled disaster in a large number of cases in America because of the improper choice of cases and the high mortality rate of colectomy in the hands of the average surgeon.

De Martel and Antoine[1] in their little monograph, *Pseudo-Appendicitis*, attempt to clarify, to some extent, this perplexing problem. The authors confine their remarks to a study of the right colon, omitting the generally accepted pathological lesions, such as carcinoma, tuberculosis, and the like. Painful syndromes of the right colon are classified as caused by: an abnormally mobile cæcum, perivisceritis of the cæco-colon, ptosis of the right colon, pericolic membranes, pericolitis of the hepatic flexure, and union of the right cæco-colon in "Cannons de Fusil." Three clinical types are observed, mild forms, frank forms, and severe and long standing forms. Whatever the nature of the anatomical lesion, they all give rise to the same symptoms, which allow one general description. The symptoms and the mechanism of production are vividly described, illustrated by anatomical drawings and rœntgenograms. The medical and surgical treatment for the individual types is described.

This work marks a distinct advance in medical knowledge and is deserving of close study by the internist and surgeon. J. A. WOLFER.

CURRENT medical literature is becoming so voluminous that the medical man cannot keep abreast of the times if he depends upon his own resources to procure from the various journals those articles in which he might be interested. A number of publishing houses are endeavoring to produce at intervals, abstracts covering certain fields. This is an advantage to the busy practitioner, in spite of the fact that the specific information on any one topic is brief. The profession at large is familiar with the Collected Papers of the Mayo Clinic and the Mayo Foundation.[2] The issue is welcomed annually because of the enormous amount of current information it offers. The 1924 number has been before the profession for several months. In this volume the policy of last year has been continued. It is a complete record of all papers for the year 1924 from the Mayo Clinic and the Mayo Foundation; every paper being published complete, abridged, abstracted or by title, depending upon its interest to the general profession.

The unusual opportunities, both physical and inspirational, offered by the Clinic, are evidenced by a prolific and instructive array of articles for the year—161 authors contributing 225 articles, truly a marvelous collection of papers of vast interest to all practitioners of medicine. J. A. WOLFER.

THORACIC surgery has become one of the well recognized branches of general surgery, with a wide scope of usefulness and a large and interesting literature. There has been, however, but one attempt made to compile the knowledge of this subject in a single text, and that is Sauerbruch's masterful two-volume *Chirurgie der Brustorgane*, published in 1924. The English speaking student, seeking information on some subject or other of thoracic surgery, and not reading German, has been confronted with two alternatives, either the necessarily sketchy accounts from the "chest" chapter of a general surgery, or the numerous articles and monographs scattered in various medical journals. Up to the present time there has been no English work dedicated to the entire field of thoracic surgery. For this reason Lilienthal's[3] two-volume *Thoracic Surgery* comes most opportunely and fills an urgent need.

It is especially fitting that Dr. Lilienthal should have been the author of this first text. Not only has he been one of the pioneers in this field, but he has done as much as any one else to develop this specialty to its present stage of importance. For years he has been the authority on lung abscess, lobectomy, etc., and whatever he has said and written has been considered as being *ex cathedra*.

The completed work has been no dissappointment, much as has been expected of it, impatiently as it has been awaited. In two volumes, written in clear and concise form, well illustrated, well arranged, well indexed, the entire subject of thoracic surgery has been covered. As much detail as is necessary for a complete understanding of the subject has been inserted, useless discussion has been avoided, and procedures once advocated but later found impracticable have been entirely omitted or just mentioned as of historical interest.

The work is to be especially recommended to the general practitioner or the internist who for the most part have not begun to comprehend how much surgery has to offer in the treatment of diseases of the lungs and mediastinum. To the surgeon,

[1] PSEUDO-APPENDICITIS. By Thierry De Martel and Edouard Antoine. Translated from the French by James A. Evans, A.B., M.D. Philadelphia, F. A. Davis Company, 1925.

[2] COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by Mrs. M. H. Mellish. Vol. xvi, 1924. Philadelphia and London: W. B. Saunders Company, 1925.

[3] THORACIC SURGERY: THE SURGICAL TREATMENT OF THORACIC DISEASE. By Howard Lilienthal, M.D. F.A.C.S. Vols. I. and II. Philadelphia and London: W. B. Saunders Company, 1925.

Lilienthal's work will appeal as the standard reference book in this branch of his specialty.

RALPH BOERNE BETTMAN.

IN an effort to evaluate the axial changes of the spine, the diagnostician must take a broad viewpoint. Many of these changes involve the adolescent girl and may have serious bearing on her future health in its relation to child bearing. In a monograph,[1] intended for practitioners, Roederer and Ledent cover the subject of vertebral deviation completely. The causes, methods of examination, direct and differential diagnosis, and the various treatments, are clearly explained. The line drawings which indicate posture exercises will aid in popularizing this work on a special subject. Only accepted methods of treatment are stressed.

KELLOGG SPEED.

IN undertaking the task of putting into one small textbook a description of the innumerable operative proceedings supposedly germane to the science of orthopedics,[2] Dr. Steindler has performed a difficult task. Disappointment may be felt that the author in the numerical richness of operations described, did not emphasize more the best and accepted methods to the exclusion of rather obsolete ones and did not also dilate more on his own results and conclusions.

In a few instances measures as yet unapproved by the test of time have been included, for instance, Royle and Hunter's work on spastic paralysis. The book represents much work on the part of one extremely well versed in the subject and its literature, and every surgeon attempting orthopedic operations will appreciate the handiness of this monograph.

KELLOGG SPEED.

[1] LA PRATIQUE DES DEVIATIONS VERTEBRALES (Scoliose—Lordose—Cyphose). By C. Roederer and R. Ledent. Paris: G. Doin & Cie, 1926.

[2] A TEXTBOOK OF OPERATIVE ORTHOPEDICS. By A. Steindler, M.D. F.A.C.S. New York and London: D. Appleton & Company, 1925.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of sender. Selections will be made for review in the interests of our readers and as space permits.

ELEMENTS OF SURFACE ANATOMY; for Students of Medicine. By I. Maclaren Thompson, B.Sc., M.B., Ch.B. (Edin.). Toronto: The Macmillan Company of Canada Limited, 1925.

TUMORS OF THE COLON AND RECTUM; Their Pathology, Diagnosis and Treatment. By Jerome M. Lynch, M.D., and Joseph Felsen, M.D. New York: Paul B. Hoeber, 1925.

I BELIEVE IN GOD AND IN EVOLUTION. By William W. Keen, M.D. 4th ed. rev. Philadelphia: J. B. Lippincott Co., 1925.

ANNUAL REPORT OF THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE OF THE UNITED STATES FOR THE FISCAL YEAR 1925. Washington: Government Printing Office, 1925.

LA CURIETHÉRAPIE DES CANCERS. By Simone Laborde. Paris: Masson et Cie, 1925.

PANCRÉATITES CHRONIQUES AVEC ICTÉRE (Causes, Diagnostic et Traitement); Valeur et Résultats éloignés de la Cholécystogastrostomie. By Dr. Peirre Mallet-Guy. Paris: Masson & Cie, 1925.

A PRATICA DA TRANSFUZAO DE SANGUE. By Mario Pardal. Rio De Janeiro: 1925.

BIOLOGIE UND PATHOLOGIE DES WEIBES; ein Handbuch der Frauenheilkunde und Geburtshilfe. Edited by Josef Halban und Ludwig Seitz. Lieferung 20. Berlin: Urban & Schwarzenberg, 1925.

L'ACTINOTERAPIA NEI MIOFIBROMI UTERINI. By Prof. Mameli Spinelli. Napoles: Vittorio Idelson, 1925.

DIAGNOSTISCHE UND THERAPEUTISCHE IRRTUEMER UND DEREN VERHUETUNG CHIRURGIE. Edited by Dr. J. Schwalbe. vol. vii. Verletzungen und chirurgische Krankheiten der Mund- und Bachenhoehle, des Halses einschl. der Speicheldruesen, der Speiseroehre, des Kehlkopfes und der Trachea. By Prof. Dr. Paul Clairmont. Leipzig: Georg Thieme, 1926.

ABDOMINAL OPERATIONS. vols. I and II. By Sir Berkeley Moynihan. Philadelphia and London: W. B. Saunders Company, 1926.

SCOLIOSIS; Rotary Lateral Curvature of the Spine. By Samuel Kleinberg, M.D., F.A.C.S. New York: Paul B. Hoeber, 1926.

LEITFADEN DER DIATHERMIE BEHANDLUNG. By Dr. A. Laqueur. Berlin: S. Karger, 1926.

CHIRURGIE DER NIERE UND DES HARNLEITERS. By Prof. Dr. James Israel and Dr. Wilhelm Israel. Leipzig: Georg Thieme, 1925.

SIMPATECTOMIA PERI-ARTERIAL. By Dr. Julio Cesar Rivas Morales.